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JAGUAR MINING INC.

TECHNICAL REPORT ON THE TURMALINA MINE COMPLEX, MINAS GERAIS STATE, BRAZIL

NI 43-101 Report

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April 5, 2019

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Report Control Form

Document Title	Technical Report on the Turmalina Mine Complex, Minas Gerais State, Brazil		
Client Name & Address	Jaguar Mining Inc. First Canadian Place 100 King Street West, 56th Floor Toronto, ON M5X 1C9 Canada		
Document Reference	Project #3082	***Status & Issue No.***	FINAL Version
Issue Date	April 5, 2019		
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1 SUMMARY

EXECUTIVE SUMMARY

Roscoe Postle Associates Inc. (RPA) was retained by Jaguar Mining Inc. (Jaguar) to assist in preparation of an update of the Mineral Reserves and Mineral Resources for the Turmalina Mine Complex, located in Minas Gerais state, Brazil, and to prepare an independent Technical Report. The purpose of this report is to support disclosure of the updated Mineral Reserves and Mineral Resources at the Turmalina Mine Complex. This Technical Report conforms to NI 43-101 Standards of Disclosure for Mineral Projects. RPA has visited the property several times, with the most recent site visit on December 11, 2018. All currency in this report is in US dollars (US$) unless otherwise noted.

Jaguar is a Canadian mining company listed on the TSX. Jaguar's current gold operations, Turmalina and Caeté, are located in the Iron Quadrangle region, a prolific greenstone belt near the city of Belo Horizonte in the state of Minas Gerais, Brazil.

The Turmalina Mine Complex consists of a number of contiguous mineral rights holdings that cover an area of approximately 5,034 ha. Along with the Turmalina Mine, the Turmalina Mine Complex includes two satellite deposits, Faina and Pontal.

Jaguar acquired the Turmalina Mine from AngloGold Ashanti Ltd. (AngloGold) in September 2004, and commenced mining operations in late 2006. The mine utilizes longhole stoping with backfill at a production rate of 1,500 tonnes per day (tpd) and ore is processed at the adjacent 2,000 tpd carbon-in-pulp (CIP) processing plant. There are two lines of production that have the ability to run independently or combined in their CIP circuits. The first line consists of two ball mills (Mills #1 and #2), and the second line consists of a third ball mill (Mill #3). In January 2017, Mill #3 was recommissioned with an estimated installed capacity of 1,600 tpd. Mine production can now be handled by Mill #3 alone, with Mills #1 and #2 on standby, which should result in lower operating costs compared to 2016. Running a combination of mills provides an overall processing capacity of 2,000 tpd, or approximately 720,000 tonnes per year (tpa).

The Mineral Resource estimate for the Turmalina Mine with an effective date of December 31, 2018 is summarized in Table 1-1. The Mineral Resources are estimated for the Turmalina

Mine (Orebodies A, B, and C) and Faina and Pontal deposits, and conform to Canadian Institute of Mining, Metallurgy and Petroleum Definition Standards for Mineral Resources and Mineral Reserves dated May 10, 2014 (CIM (2014) definitions).

TABLE 1-1 SUMMARY OF MINERAL RESOURCES – DECEMBER 31, 2018
Jaguar Mining Inc. – Turmalina Mine Complex

Category	Tonnes (000)	Grade (g/t Au)	Contained Oz Au (000)
Turmalina			
Measured	1,767	5.37	305
Indicated	1,486	5.70	272
Sub-total M&I	**3,253**	**5.52**	**577**
Inferred	1,066	4.31	148
Faina			
Measured	72	7.39	17
Indicated	189	6.66	42
Sub-total M&I	**261**	**6.87**	**58**
Inferred	1,542	7.26	360
Pontal			
Measured	251	5.00	40
Indicated	159	4.28	22
Sub-total M&I	**410**	**4.72**	**62**
Inferred	130	5.03	21
Total Turmalina, Faina, and Pontal deposits			
Measured	2,090	5.40	362
Indicated	1,834	5.68	336
Total M&I	**3,924**	**5.53**	**697**
Inferred	2,738	6.00	529

Notes:
1. CIM (2014) definitions were followed for Mineral Resources.
2. Mineral Resources include the Turmalina deposit, Faina deposit, and Pontal deposit.
3. Mineral Resources are inclusive of the Mineral Reserves at the Turmalina deposit.
4. Mineral Resources are estimated at a cut-off grade of 2.1 g/t Au at Turmalina, 3.8 g/t Au at Faina, and 2.9 g/t Au at Pontal.
5. Mineral Resources at the Turmalina deposit include all drill hole and channel sample data and mining excavations as of December 31, 2018. Mineral Resources at the Faina and Pontal deposits include drill hole information as of December 31, 2014.
6. Mineral Resources are estimated using a long-term gold price of US$1,500 per ounce for the Turmalina deposit and US$1,400 per ounce for the Faina and Pontal deposits.
7. Mineral Resources are estimated using an average long-term exchange rate of 3.70 Brazilian Reais: 1 US Dollar for the Turmalina deposit and 2.50 Brazilian Reais: 1 US Dollar for the Faina and Pontal deposits.
8. A minimum mining width of two metres was used.
9. Bulk density is 2.83 t/m^3 for Orebodies A and B and 2.91 t/m^3 for Orebody C at the Turmalina deposit.
10. Gold grades are estimated by the ordinary kriging interpolation algorithm using capped composite samples.
11. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
12. Numbers may not add due to rounding.

Mineral Reserves are estimated for the northwest and southeast portions of Orebody A (ANW and ASE) and southeast portion of Orebody C (CSE) only and are summarized in Table 1-2.

TABLE 1-2 MINERAL RESERVE ESTIMATE – DECEMBER 31, 2018
Jaguar Mining Inc. – Turmalina Mine Complex

Orebody	Proven Reserves			Probable Reserves			Proven and Probable Reserves		
	ROM (000 t)	Grade (g/t Au)	Oz Au (000)	ROM (000 t)	Grade (g/t Au)	Oz Au (000)	ROM (000 t)	Grade (g/t Au)	Oz Au (000)
Orebody ANW	116	6.40	24	192	6.60	40	308	6.52	64
Orebody ASE	229	4.64	34	65	3.36	7	294	4.36	41
Orebody CSE	388	3.53	44	418	5.85	79	806	4.73	123
Total	**733**	**4.33**	**102**	**675**	**5.82**	**126**	**1,408**	**5.05**	**228**

Notes:
1. CIM (2014) definitions were followed for Mineral Reserves.
2. Mineral Reserves were estimated at a break-even cut-off grade of 2.5 g/t Au, an incremental cut-off grade of 1.4 g/t Au.
3. Mineral Reserves are estimated using an average long-term gold price of US$1,300 per ounce, and an exchange rate of 3.70 Brazilian Reais: 1 US Dollar.
4. A minimum mining width of two metres was used.
5. Bulk density is 2.83 t/m^3 for Orebodies A and B and 2.91 t/m^3 for Orebody C at the Turmalina Mine.
6. Numbers may not add due to rounding.

RPA is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other factors that could materially affect the Mineral Resource and Mineral Reserve estimates.

CONCLUSIONS

Both open pit and underground mining methods have been employed on the property, however, only the underground mine is currently operating.

GEOLOGY AND MINERAL RESOURCES

- It is RPA's opinion that the Turmalina Mineral Resource estimates were prepared in a professional and diligent manner by qualified professionals and that the estimates comply with CIM (2014) definitions.

- The total Mineral Resources for the Turmalina Mine Complex comprise approximately 3.92 million tonnes at an average grade of 5.53 g/t Au containing 697,000 ounces of gold in the Measured and Indicated Mineral Resource category and approximately 2.74 million tonnes at an average grade of 6.00 g/t Au containing approximately 529,000 ounces of gold in the Inferred Mineral Resource category. The Mineral Resources include the Turmalina deposit and two satellite deposits, Faina and Pontal. A cut-off grade of 2.10 g/t Au was used to report the Mineral Resources for the Turmalina deposit, and cut-off grades of 3.8 g/t Au and 2.9 g/t Au were used to report the Mineral Resources for the Faina and Pontal deposits, respectively.

- Reconciliation studies on a quarterly basis show that the monthly Mine-to-Plant (F2) results exhibit a good correlation between the mine and the plant data throughout most of the 2017 and 2018 production periods, with the monthly block model predicted grades being generally more than those processed by the plant and the block model predicted tonnes being generally less than those processed by the plant.

- In general terms, RPA observes that there is good agreement between the plant data and the block model for the 2017 and 2018 period. RPA is of the opinion that this agreement is suggesting that the sampling strategies, assaying methods, and estimation procedures currently used at the mine to prepare the grade block models are producing reasonable predictions of the tonnages, grades, and contained metal that are being received at the processing plant.

- In RPA's opinion, the observed reconciliation variances can be ascribed to four factors:
    - Inaccuracies in the Cavity Monitoring System (CMS) shapes,
    - Inaccurate estimates of the block model tonnages and grades due to the use of designed stope volumes rather than CMS shapes,
    - The discovery of additional ore during the development process that was not captured by the block model, and
    - Overall block model predicted grades being too high due to slightly optimistic capping values.

- Two new mineralized lenses discovered in 2018 are located between Orebody A and the previously known lenses comprising Orebody C.

MINING AND MINERAL RESERVES

- The Turmalina Mine is a well run and professional operation. The mine produces 1,500 tpd.

- It is RPA's opinion that the Turmalina Mineral Reserve estimates were prepared in a professional and diligent manner by qualified professionals and that the estimates comply with CIM (2014) definitions.

- Proven and Probable Mineral Reserves total 1.41 million tonnes at a grade of 5.05 g/t Au, containing approximately 228,000 ounces of gold. Mineral Reserves are limited to Orebody A and Orebody C.

- Mineral Reserves support a mine life of four years.

- The thicker portions of Orebody A, now considered for transverse mining in a primary/secondary sequence, comprise the highest grade, most productive portion of the Mineral Reserves. The majority of Orebody A will be mined using longhole stoping in a retreat sequence.

- Comparing Levels 7, 8, 9, and 10 shows that the thicker, high grade portion of Orebody A is increasing in lateral extent with depth. This trend has continued to the planned level of 13, however, the overall strike of the orebody has decreased.

- There is good potential for increasing Mineral Reserves by completing infill drilling of Inferred Mineral Resources at depth in Orebody A.

- The removal of rib pillars and timely placement of paste fill has greatly improved extraction of the orebody and has increased the mill feed tonnage.

METALLURGY AND PROCESSING

- The plant at the Turmalina Mine is well run and achieves consistent recoveries.

- Production capacity for the plant exceeds the ability of the mine to deliver ore.

CAPITAL AND OPERATING COSTS

- Direct capital costs over the Life of Mine Plan (LOMP) total $16.7 million including $9.3 million for the mine and $7.4 million for exploration. The direct capital spent in the mine is for new equipment.

- Sustaining capital costs are estimated to be $15.6 million, of which $0.8 million is spent on rebuilds. Reclamation and closure costs are estimated to total $5.1 million.

- Life of Mine (LOM) operating costs are forecast to average $85.00/t. Strengthening of the US dollar against the BRL over the last few years has had a significant impact in reducing US$ unit costs. Jaguar used an exchange rate of US$1.00 = 3.70 BRL for 2019. The exchange rate assumptions are consistent with forecasts.

- All-In Sustaining cost (as defined by the World Gold Council) for the Turmalina Mine is $1,048/oz, including reclamation and closure.

RECOMMENDATIONS

RPA has the following recommendations:

GEOLOGY AND MINERAL RESOURCES

Exploration

- The results obtained from the Zona Basal target area merit further examination by means of a preliminary diamond drilling program. In RPA's opinion, the soil sampling and geological mapping programs should be extended along the southwestern projection of the Zona Basal stratigraphy to search for the presence of additional gold-bearing mineralization in this area.

- Exploration drilling of the down-plunge and along-strike projection of Orebodies A and C is warranted and justified.

- Consideration should be given to locating additional, parallel mineralized zones in the hanging wall of Orebody B and in the footwall units of Orebody C.

Quality Assurance/Quality Control

- The Quality Assurance/Quality Control (QA/QC) program should be amended to include the channel samples.
- The database should be amended as a minimum to improve the data extraction functionality so that standard QA/QC control charts can be prepared.
- The assay laboratory automatically re-assays all samples containing gold grades greater than 30 g/t Au, and the average of the re-assays are reported to the sites. All sample results should be reported to the site, without averaging.
- Make a slight modification to the drill hole database assay information where the final gold assay used to prepare grade estimates is the average of all assays for a given sample. At present, only the first assay is used. This information can be captured by the creation of an additional column in the assay table.
- Establish clear criteria for acceptance or rejection of drill hole and channel sample data in the drill hole database.
- Establish data screening protocols for review of data quality for newly acquired data prior to inserting into the master database.
- Send a small number of pulps from the 2018 drilling program to an external laboratory for duplicate analysis.
- The threshold of 30 g/t Au is high. Re-assay thresholds of 10 g/t Au to 15 g/t Au are commonly used in other gold operations.
- Include the certificate number for each assay batch into Jaguar's central database (BDI).
- Update the central BDI database to store drill core recovery, channel sample recovery, and sample tracking (lost sample) information. This will assist in deciding how to address null values in future resource estimates.
- Carry out a review of the surveying practices and quality control procedures being used to ensure that all drill hole collars are accurately located prior to entry into the final drill hole database.

Mineral Resources

- Complete updating the written procedures for the collection of geological and sampling information. Conduct a training session to present the procedures to all geological staff. The written procedures for entry of this data into the central database and its management should also be completed.
- Update the core logging and sampling procedures so that the logging geologist ensures that a full series of samples are taken through those portions of the drill holes that are expected to intersect the mineralized zones. The samples should cover not only the expected mineralized intervals but extend a short distance into the adjacent wall rocks as well.

- Correct the erroneous or uncertain information for those excluded drill holes that are located in the as-yet unmined portions of the Turmalina deposit. For those drill holes and channel samples that remain, RPA recommends that they be removed from the active database into a database that is dedicated specifically for these records.

- Make a slight modification to the logging procedures whereby detailed information regarding the mineralized intervals will be brought forward from the remarks column and inserted as a major level entry in the drill logs to assist in preparation of future updates to the Mineral Resources.

- Code the block model for the mined out excavations using both the development and the stope excavation models.

- Carry out geological mapping of all available underground excavations in the vicinity of the Orebody C mineralized wireframes. The results of this geological mapping should be used to prepare a lithological model to be used to improve the allocation of the density measurements for future Mineral Resource updates.

- Modify the mineralized wireframe construction strategy to use a cut-off grade that more closely reflects the Mineral Reserve cut-off grade for each orebody.

- Continue to collect bulk density measurements for any newly discovered mineralization.

- Undertake studies to examine the relationship of the gold values to structural, alteration, or lithologic features (such as the presence of quartz veining, for example) to aid in the understanding of the distribution of the higher grade gold values seen in Orebodies A and C.

- Re-examine the stratigraphic/lithologic controls on mineralization for Orebody B for the possibility of generating drill targets.

- Consider the use of a dynamic anisotropy method for estimation of gold grades into the model.

- Review the U-Fo estimation method as developed by the Advanced Laboratory for Geostatistical Supercomputing (ALGES), at the University of Chile in Santiago for preparing grade estimates for non-tabular mineralized zones.

- Carry out a short study to search for the optimum selection of input parameters to reduce the number of estimation artifacts for several mineralized lenses in Orebody C that have areas of lower sample density. The study should begin with the examination of the impact of the number of informing samples per quadrant on the resulting estimate.

- Collect additional drill hole information in these areas to improve the confidence level of the Mineral Resource estimate, to reduce and remove the estimation artifacts, and to search for the down-dip projections of the mineralization.

- Re-evaluate the Mineral Resource estimates for the Faina and Pontal deposits if any material changes occur to the values of the cut-off grade input parameters.

MINING AND MINERAL RESERVES

- Consider modelling mining costs by orebody, such that variable and incremental cut-off grades can be determined by orebody and the Mineral Reserve estimate, LOMP, and processing capacity can be optimized.

- Monitor geotechnical and modifying factor performance of the newly adopted primary and secondary transverse stopes to determine where improvements in mine planning can be achieved.

- Integrate ground control and rock mechanics analysis into the mine planning process to improve stability and reduce dilution.

- Balance production levels between Orebody A and Orebody C for improved production stability and operationally achievable plan over the LOM.

- Consider an annual long term planning cycle inclusive of strategic asset planning, Mineral Resource, and Mineral Reserve estimation for all Jaguar operations.

- Balance production levels between Orebody A and Orebody C for improved production stability and plan achievability over the LOM.

- The cost data available from Turmalina is not easily categorized. Unit mining costs vary between Orebody A and Orebody C, given significant differences between mining width, production rates, ground conditions, and haul distances. The mill has excess production capacity, not otherwise put to use. Undertake a detailed incremental cost analysis, split by orebody, to ensure that uneconomic material is not sent to the mill.

MINERAL PROCESSING AND METALLURGICAL TESTING

- Based on the information provided, the metallurgical testwork on samples from the Faina, Pontal, and Orebody D deposits has been carried out to a preliminary level only. Metallurgical testing should continue on these potentially refractory deposits to help determine the most appropriate processing route to be adopted.

- Options for the use of excess processing capacity for toll milling should be investigated.

TECHNICAL SUMMARY

PROPERTY DESCRIPTION AND LOCATION

The Turmalina Mine Complex is located in the Conceição do Pará municipality in the state of Minas Gerais, approximately 120 km northwest of Belo Horizonte and six kilometres south of Pitangui, the nearest important town.

The property comprises a number of mineral rights holdings granted by the Agência Nacional de Mineração (ANM) that cover an area of 5,034 ha. The mine is centred at approximately 19°44’36” south latitude and 44°52’36” west longitude.

Jaguar has 100% ownership subject to a 5% net revenue interest up to $10 million and 3% thereafter, to an unrelated third party. In addition, there is a 0.5% net revenue interest payable to the surface landowner.

EXISTING INFRASTRUCTURE

The Turmalina Mine includes a nominal 2,000 tpd processing plant and tailings disposal area. Electrical power is obtained from the national grid. There is no infrastructure related to the Faina and Pontal historic open pit operations.

HISTORY

Gold was first discovered in the area in the 17th century, and through the 19th century, intermittent small-scale production took place from alluvial terraces and outcropping quartz veins. Gold production exploited alluvium or weathered material, including saprolite and saprolite-hosted quartz veins.

AngloGold controlled the Turmalina Mine Complex mineral rights from 1978 to 2004 through a number of Brazilian subsidiaries. It explored the area extensively between 1979 and 1988 using geochemistry, ground geophysics, and trenching, which led to the discovery of the Turmalina, Satinoco (later renamed as Orebody C), Faina, and Pontal deposits, and other mineralized zones. In 1992 and 1993, it mined 373,000 t of oxide ore from open pits at these zones recovering 35,500 oz of gold using heap leach technology. Jaguar acquired the Turmalina properties in 2004.

GEOLOGY AND MINERALIZATION

The Turmalina deposits are located in the western part of the Iron Quadrangle, which was the principal region for the Brazilian hard rock gold mining until 1983 and accounted for approximately 40% of Brazil's total gold production. Gold was produced from numerous deposits, primarily in the northern and southeastern parts of the Iron Quadrangle, mostly hosted by Archean or Early Proterozoic-aged banded iron formations (BIF) contained within greenstone belt supracrustal sequences.

The Turmalina Mine Complex is underlain by rocks of Archaean and Proterozoic age. Archaean units include a granitic basement, overlain by the Pitangui Group, a greenstone belt sequence of ultramafic to intermediate volcanic flows and pyroclastics and associated sediments. The Turmalina deposit is hosted by chlorite-amphibole schist and biotite schist units within the Pitangui Group. A sequence of sheared, banded, sulphide iron formation and chert lies within the stratigraphic sequence. The stratigraphy locally strikes to azimuth 135º.

The Turmalina deposits are believed to be typical examples of mesothermal, epigenetic deposits that are enclosed by host rocks that have undergone amphibolite-grade metamorphism.

Gold mineralization in the Turmalina deposits occurs in fine grains associated with sulphides in sheared schists and BIF sequences. Gold particles are mostly associated with arsenopyrite, quartz, and micas (sericite and biotite).

EXPLORATION STATUS

Initial exploration efforts by Jaguar in 2004 focused on the re-interpretation of the AngloGold data (trenches, soil geochemistry, and drilling) to better understand the local geology. In 2006 to 2008, Jaguar completed trenching and channel sampling, followed by three phases of drilling.

Current drilling and sampling practices involve the initial delineation of the mineralized lenses using surface-based drill holes. Once sufficient primary underground access has been established, the mineralized lenses are further outlined by underground-based drill holes at a nominal spacing of 25 m to 50 m. As development of the underground access progresses on the ore, a series of channel samples are taken in two locales (one set on the face and one set along the back) for each round. While several exploration targets are present on the mine property, the focus of Jaguar's 2018 diamond drilling program was on the conversion of existing Mineral Resources to Mineral Reserves and testing of the down-dip extension of Orebodies A and C for the continuation of the gold-bearing zones.

MINERAL RESOURCES

TURMALINA DEPOSIT

The database for the Turmalina deposit comprises 3,934 drill holes and 16,246 channel samples. The estimate was generated from a block model constrained by 3D wireframe models that were constructed using a minimum width of approximately two metres. A capping value of 50 g/t Au was applied for all three orebodies. The gold grades were interpolated by the OK and ID^3 interpolation algorithm using capped composited assays. Solid models of the underground excavations have been prepared using available survey data as of December 31, 2018. These solid models were used to code the block model for the mined out portions of the deposit.

The mineralized material for each orebody was classified into the Measured, Indicated, or Inferred Mineral Resource categories on the basis of the search ellipse ranges obtained from the variography study, the observed continuity of the mineralization, the drill hole and channel sample density, and previous production experience with these orebodies.

Reconciliation studies were completed by Jaguar on both monthly and quarterly periods. The block model data is generally in good agreement with the plant data for the 2017 and 2018 period. On a metal basis, the block model was within 2% and 7% of the plant for 2017 and 2018, respectively.

FAINA DEPOSIT

The database for the Faina deposit comprises 3,992 drill holes and channel samples for an aggregate length of 52,474 m. The estimate was generated from a block model constrained by a total of 39 3D wireframe models that were constructed using a minimum width of approximately two metres. Two topography models were created, one representing the limit of open pit excavation and the second representing the current topography where a portion of the open pit has been backfilled. A solid model of the underground excavation volume was created using existing centre-line survey data and a general cross section profile. A capping value of 30 g/t Au was applied to channel samples and a capping value of 25 g/t Au was applied to drill hole samples. The gold grades were interpolated using several interpolation algorithms using capped composited assays. The Mineral Resources are reported using the gold grades estimated by the ID^3 method.

The mineralized material for each wireframe was classified into the Measured, Indicated, or Inferred Mineral Resource categories on the basis of the search ellipse ranges obtained from the variography study, the observed continuity of the mineralization, the drill hole and channel sample density, and the presence of underground access.

The Mineral Resources for the Faina deposit have been prepared under the conceptual scenario that the contained refractory gold-bearing material will be excavated by means of underground mining methods and transported to the Turmalina plant for processing. A gold-rich flotation concentrate is envisioned to be generated after appropriate upgrades have been made to the existing plant. The gold-rich flotation concentrate would then be shipped or sold to a domestic source for recovery of the gold.

PONTAL DEPOSIT

The database for the Pontal deposit comprises 3,590 drill holes and channel samples for an aggregate length of 19,283 m. The estimate was generated from a block model constrained by a total of 16 3D wireframe models that were constructed using a minimum width of approximately two metres. Two topography models were created that covered the local area of each of the two deposits at Pontal, LB1, and LB2. An approximation of the underground excavation volume was created by digitizing the outlines in plan view from historical underground mapping and sampling programs carried out at the LB1 deposit. The digitized plan view strings were projected upwards by a constant distance of 2.5 m to create the solid model of the underground excavations. A capping value of 30 g/t Au was applied to samples at the LB1 deposit and a capping value of 10 g/t Au was applied to samples at the LB2 deposit. The gold grades were interpolated using several interpolation algorithms using capped composited assays. The Mineral Resources are reported using the gold grades estimated by the ID^3 method.

The mineralized material for each wireframe was classified into the Measured, Indicated, or Inferred Mineral Resource categories on the basis of the search ellipse ranges obtained from the variography study, the observed continuity of the mineralization, the drill hole and channel sample density, and the presence of underground access. The Mineral Resources for the Pontal deposit have been prepared under the conceptual scenario that the contained refractory gold-bearing material will be excavated by means of underground mining methods and transported to the Turmalina plant for processing. A gold-rich flotation concentrate is envisioned to be generated after appropriate upgrades have been made to the existing plant. The gold-rich flotation concentrate would then be shipped or sold to a domestic source for recovery of the gold.

MINERAL RESERVES

The Mineral Reserves consist of selected portions of the Measured and Indicated Mineral Resources within designed stopes and associated development. The stope design was completed by MCB Serviços E Mineração (MCB), a Brazilian consulting group.

Dilution was applied to the designed stopes as planned dilution (portions of the stopes that project outside the resource wireframes) and unplanned dilution (a factor to account for overbreak). Planned and unplanned dilution estimates average 25%, consistent with recent operating results and reconciliation data.

Extraction (mining recovery) is assumed to be 100%. Although some losses are encountered during blasting and mucking, they are minimal, and reconciliation to mill results indicate that high dilution/high extraction assumptions match up well.

A break-even cut-off grade of 2.5 g/t Au was estimated for Mineral Reserves, using a gold price of US$1,300/oz, and average gold recovery of 90% and 2018 cost data for the Turmalina Mine. Gold prices used for Mineral Reserves are based on consensus, long term forecasts from banks, financial institutions, and other sources.

MINING

The Turmalina Mine consists of a number of tabular zones grouped into three orebodies - Orebodies A, B, and C.

The main production of the mine has been from Orebody A, which is folded, steeply east dipping, with a strike length of approximately 250 m to 300 m and an average thickness of six metres. Mineralization has been outlined to depths of 900 m below surface. The southern portion of Orebody A is composed of two parallel narrow veins. The northern portion of Orebody A is much the same as the southern portion, however, the two parallel zones nearly, or completely, merge, and therefore the zone is much wider overall (up to 10 m).

Orebody B includes three thinner, lower grade lenses parallel to Orebody A. Two of the lenses are located approximately 50 m to 75 m in the structural hanging wall and are accessed by a series of cross-cuts that are driven from Orebody A. The third lens is located possibly along the axial plane. The mineralization in this deposit has been outlined along a strike length of approximately 350 m to 400 m and to depths of 900 m below surface. Orebody B is narrow along its entire strike length ranging from one metre to 7.5 m in thickness from hanging wall to footwall.

Orebody C is a series of 26 lenses that are located to the west in the structural footwall of Orebody A and are generally of lower grade. They strike northwest and dip steeply to the northeast. A minor amount of production has been achieved from these lenses to date. The mineralization in this deposit has been outlined along a strike length of approximately 800 m to 850 m and to depths of 700 m to 750 m below surface.

Orebodies A and C are the primary structures being mined, while mining in Orebody B has recently been halted. Orebody A is located in the footwall of the shear zone and Orebody B is located in the hanging wall of the shear structure.

Orebody A is closest to the main ramp and is accessed first. Development is currently progressing to Level 11 in Orebody A.

Orebody C is a secondary system being mined to the west of the portal. It is of lower grade than Orebody A or Orebody B. Orebody C is accessed from the main ramp at Level 02. A separate internal ramp was recently completed for Orebody C, which reduces the haul distance to the run-of-mine ore stockpile, and reduces traffic on the main ramp.

MINING METHOD

The mining method currently in use is longhole sublevel stoping with delayed backfill.

The mine is accessed from a 5 m by 5 m primary decline located in the footwall of the deposit. The mine is divided into 75 m levels. Five sublevels, spaced 15 m apart vertically, are driven from the main ramp. A five metre thick sill pillar is left below each main level.

At each level and sublevel, drifts are developed in the mineralized zone to expose the hanging wall contact. The drift is extended in both directions along strike, under geological control for alignment, continuing to expose the contacts until the limits of the orebody are reached.

Past mining used a longitudinal retreat sequence for Orebody A and Orebody B. Stope extraction began at the ends of the levels and retreated back towards the access. Stopes were mined from several individual levels simultaneously in order to provide the required number of active workplaces needed to meet production targets.

The retreat sequence, and the need to complete Orebody B mining before cutting off access by mining Orebody A, reduced productivity by limiting the number of stopes available for mining at a given time.

The current LOMP does not consider mining of Orebody B, and involves a change in mine design. Starting with Level 9, Orebody A is mined in a primary/secondary sequence via transverse access to the thick centre portion, requiring additional accesses developed in waste. Each primary or secondary stope is 15 m along strike, with no pillars. The design change has the effect of increasing the number of available workplaces, and de-links the narrow, lower-productivity ends from the centre.

In RPA's opinion, this innovation is critical to improving the mine's ability to fill the mill to capacity with high grade ore.

Development waste is used for backfill, on an unconsolidated basis in secondary stopes and with the addition of cement in primary stopes. Paste fill is used to tight fill the stopes immediately below the sill pillars, where consistent product of paste fill is critical. The paste fill product is prepared from detoxified CIP tailings in a shear mixer and batch plant located near the mill.

Although mining of Orebody B is not in the LOMP, and the orebody is no longer included in Mineral Reserves, future access is possible, either by mining through cemented paste fill and supporting appropriately, or by mining concurrently with the thinner ends of Orebody A.

LIFE OF MINE PLAN

The production schedule is summarized in Table 1-3 and covers a mine life of four years based on Mineral Reserves.

TABLE 1-3 LOMP PRODUCTION SCHEDULE
Jaguar Mining Inc. – Turmalina Mine Complex

Item	Units	2019	2020	2021	2022	Total
Total Mill Feed	Tonnes (000)	376	326	402	305	**1,408**
	g/t Au	4.95	5.78	4.69	4.84	**5.05**
Recovery	%	91.0%	91.0%	91.0%	91.0%	**91.0%**
Gold Produced	Ounces (000)	**55**	**55**	**55**	**43**	**208**

Scheduling is based on productivities achieved in the current operations. Development was limited to 60 m per month on the main ramp and 30 m per month on any single heading elsewhere. Stope scheduling follows the primary/secondary sequence where transverse mining is applied, otherwise it is based on retreat mining and includes delays for backfilling and cement curing.

MINERAL PROCESSING

The plant has a nominal processing capacity of 2,000 tpd, or 720,000 tpa. Since inception, the plant has been achieving annual overall recoveries of between 87% and 92%. The process flowsheet includes two-stage crushing and screening to minus 9.5 mm (-3/8 in.), grinding using ball mills, thickening, cyanide leaching, CIP, elution, electrowinning, and smelting. The tailings are conveyed to a detoxification unit for arsenic removal and cyanide destruction and then are pumped to the paste fill plant to be used either for mine backfill or deposited on a dry-stack storage area. Process tailings have also been dry-stacked in completed open pits on the mine site.

In January 2017, Mill #3 was recommissioned with an estimated installed capacity of 1,600 tpd. Using only Mill #3, Turmalina will be able to achieve the entire throughput of the plant with a lower operating cost, through electricity consumption savings, compared to using both Mills #1 and #2 in 2016. As a result, Mills #1 and #2 have been taken off-line for maintenance and will be kept on standby mode in the future. The addition of Mill #3 allows the processing plant to be run at a full capacity of 2,000 tpd, or approximately 720,000 tpa, in future years using a combination of mills.

ENVIRONMENTAL AND PERMITTING CONSIDERATIONS

Jaguar has all permits necessary for continuing operation of the Turmalina Mine.

As of December 31, 2018, Jaguar maintained progressive rehabilitation and reclamation provisions of US$5.1 million which represent the undiscounted, uninflated future payments for the expected rehabilitation costs.

CAPITAL AND OPERATING COST ESTIMATES

Costs for the LOMP were estimated in BRL, based on recent operating results and Jaguar budgets.

A summary of capital requirements anticipated over the LOMP is provided in Table 1-4.

TABLE 1-4 LOMP CAPITAL COST SUMMARY
Jaguar Mining Inc. –Turmalina Mine Complex

	Units	Total	2019	2020	2021	2022
Direct Cost						
Mining	US$ (000)	**9,324**	4,865	4,459	-	-
Processing	US$ (000)	**-**	-	-	-	-
Infrastructure	US$ (000)	**-**	-	-	-	-
Exploration	US$ (000)	**7,357**	1,839	1,839	1,839	1,839
Total Direct Cost	US$ (000)	**16,681**	6,704	6,299	1,839	1,839
Sustaining						
Sustaining	US$ (000)	**15,572**	8,021	2,617	2,467	2,467
Reclamation and Closure	US$ (000)	**5,073**	184	135	100	4,495
Total Capital Cost	**US$ (000)**	**54,007**	**21,613**	**15,349**	**6,245**	**10,640**

Operating costs for the LOMP are shown in Table 1-5. Recent strengthening of the US dollar against the BRL has had a significant impact in reducing US$ unit costs. Jaguar used an exchange rate of US$1.00 = 3.70 BRL for 2019.

Operating cost estimates include mining, processing, and general and administration (G&A) expenses. Operating costs are budget cost projections based on actual costs incurred over the past year.

TABLE 1-5 LOM OPERATING COST SUMMARY
Jaguar Mining Inc. – Turmalina Mine Complex

Unit Costs	Unit	Average	2019	2020	2021	2022
Mining	US$/t milled	43.15	52.67	46.17	37.91	35.11
Processing	US$/t milled	26.41	33.49	33.49	33.49	33.49
G&A	US$/t milled	8.39	8.23	9.61	7.80	8.06
Total Unit Operating Cost	**US$/t milled**	**85.03**	**94.39**	**89.28**	**79.19**	**77.66**

There are additional corporate overhead costs associated with the Belo Horizonte and Toronto offices, as well as royalties and refining costs, which are not included in the operating cost estimate.

2 INTRODUCTION

Roscoe Postle Associates Inc. (RPA) was retained by Jaguar Mining Inc. (Jaguar) to carry out an audit of the 2018 Mineral Reserves and Mineral Resources for the Turmalina Mine Complex, located in Minas Gerais state, Brazil, and to prepare an independent Technical Report. The purpose of this report is to support disclosure of the updated Mineral Reserves and Mineral Resources. This Technical Report conforms to NI 43-101 Standards of Disclosure for Mineral Projects.

Jaguar was formed on March 1, 2002 for the purpose of developing small and medium sized mineral properties in Brazil that have well defined gold resources and reserves with upside exploration potential. Mineração Serras do Oesto (MSOL) is a Brazilian company holding numerous properties in Minas Gerais state, including the Turmalina Mine Complex, and was formed by ex-AngloGold Ashanti Ltd. (AngloGold) geologists and engineers who believed that many of the small gold properties in Minas Gerais had mining potential if run separately as small coordinated operations. MSOL was acquired by Jaguar as its Brazilian subsidiary in 2002. Jaguar's first operation was the Sabará deposit, a small oxide gold heap leach operation which was in production for four years until resource exhaustion.

Jaguar's current gold operations, Turmalina and Caeté, are located in the Iron Quadrangle region, a prolific greenstone belt near the city of Belo Horizonte in the state of Minas Gerais, Brazil. Jaguar is a Canadian-chartered entity with its principal executive office in Toronto, Ontario, Canada and administrative office in Belo Horizonte, Brazil. The common shares of Jaguar are currently listed on the TSX under the symbol JAG.

The Turmalina Mine Complex consists of a number of contiguous mineral rights holdings that cover an area of approximately 5,034 ha. Gold mineralization has been discovered at three deposits, namely the Turmalina, Faina and Pontal deposits. Jaguar commenced mining operations in late 2006 from the Turmalina deposit. The mine utilizes longhole stoping with backfill at a production rate of 1,500 tonnes per day (tpd) and ore is processed at the adjacent 2,000 tpd carbon-in-pulp (CIP) processing plant.

SOURCES OF INFORMATION

A site visit to the Turmalina Mine Complex was carried out by Mr. Jeff Sepp, P. Eng., RPA Senior Mining Engineer, on December 11, 2018. Mr. Sepp was accompanied by Helbert Taylor Vieira from Jaguar. The site visit comprised stops at selected underground locations in Orebodies A and C to review the ground conditions and mining methods employed. RPA had visited the site previously on November 20, 2014 and December 13, 2017.

A summary of the Jaguar staff and its consultants other than the named authors of this Technical Report who contributed to the preparation of the Mineral Resource and Mineral Reserve estimates for the Pilar and Roça Grande mines is presented below.

Name	Position	Company
Benjamin Guenther	Chief Executive Officer	Jaguar
Kevin Weston	VP - Operations	Jaguar
Hashim Ahmed	Chief Financial Officer	Jaguar
Jonathan Victor Hill	Exploration & Geology – Expert Advisor	Jaguar
Jean-Marc Lopez	Technical Advisor to the Board	Jaguar
Alexandre Heberle	General Manager	Jaguar
Vitor Ferraz Viana	Technical Service Manager	Jaguar
Helbert Taylor Vieira	Resources and Reserves Manager	Jaguar
Armando José Massucato	Exploration Manager	Jaguar
Frederico Lima de Paula	Geology Coordinator	Jaguar
Marco Aurelio Sequetto Pereira	Resource Geologist	Jaguar
Jaime Andress Corredor Herrera	Geotechnical Geologist	Jaguar
Jéssica Morgana Ribeiro Santana	Geotechnical Engineer	Jaguar
Vitor Balbys Moura	Mine Planning Coordinator	Jaguar
Francielle da Silva Rodrigues	Mine Planning Engineer	Jaguar
Williams Pinto dos Santos	Mine Geologist	Jaguar
Walace Vinícius do Carmo Fernandes	Mine Geologist	Jaguar
Francisco Bittencourt Oliveira	Senior Mining Engineer	MCB Serviços e Mineração
Sérgio Sartori	Senior Mining Engineer	MCB Serviços e Mineração
Bruno Tomaselli	Senior Mining Engineer	MCB Serviços e Mineração

Mr. Sepp, P.Eng., RPA Senior Mining Engineer, Mr. Reno Pressacco, M.Sc.(A), RPA Principal Geologist, and Mr. Avakash Patel, P.Eng, RPA Principal Metallurgist, are the Qualified Persons for this Technical Report. Mr. Sepp prepared Sections 15, 16, 18 to 22, and 24. Mr. Pressacco prepared Sections 4 to 12, 14, and 23. Mr. Patel prepared Sections 13 and 17. All authors share responsibility for Sections 1, 2, 3, 25, 26, and 27 of this Technical Report.

The documentation reviewed, and other sources of information, are listed at the end of this report in Section 27 References.

LIST OF ABBREVIATIONS

Units of measurement used in this report conform to the metric system. All currency in this report is US dollars (US$) unless otherwise noted.

a	annum	L	litre
A	ampere	lb	pound
Acfm	actual cubic feet per minute	L/s	litres per second
bbl	barrels	m	metre
btu	British thermal units	M	mega (million); molar
°C	degree Celsius	m^2	square metre
C$	Canadian dollars	m^3	cubic metre
cal	calorie	µ	micron
cm	centimetre	MASL	metres above sea level
cm^2	square centimetre	µg	microgram
d	day	m^3/h	cubic metres per hour
dia	diameter	mi	mile
dmt	dry metric tonne	min	minute
dwt	dead-weight ton	µm	micrometre
°F	degree Fahrenheit	mm	millimetre
ft	foot	mph	miles per hour
ft^2	square foot	MVA	megavolt-amperes
ft^3	cubic foot	MW	megawatt
ft/s	foot per second	MWh	megawatt-hour
g	gram	oz	Troy ounce (31.1035g)
G	giga (billion)	oz/st, opt	ounce per short ton
Gal	Imperial gallon	ppb	part per billion
g/L	gram per litre	ppm	part per million
Gpm	Imperial gallons per minute	psia	pound per square inch absolute
g/t	gram per tonne	psig	pound per square inch gauge
gr/ft^3	grain per cubic foot	R$ or BRL	Brazilian Real
gr/m^3	grain per cubic metre	RL	relative elevation
ha	hectare	RPM	revolutions per minute
hp	horsepower	s	second
hr	hour	st	short ton
Hz	hertz	stpa	short ton per year
in.	inch	stpd	short ton per day
in^2	square inch	t	metric tonne
J	joule	tpa	metric tonne per year
k	kilo (thousand)	tpd	metric tonne per day
kcal	kilocalorie	US$	United States dollar
kg	kilogram	USg	United States gallon
kgf/cm^2	kilogram force per square cm	USgpm	US gallon per minute
km	kilometre	V	volt
km^2	square kilometre	W	watt
km/h	kilometre per hour	wmt	wet metric tonne
kPa	kilopascal	wt%	weight percent
kVA	kilovolt-amperes	yd^3	cubic yard
kW	kilowatt	yr	year
kWh	kilowatt-hour		

3 RELIANCE ON OTHER EXPERTS

This report has been prepared by RPA for Jaguar. The information, conclusions, opinions, and estimates contained herein are based on:

- Information available to RPA at the time of preparation of this report, and
- Assumptions, conditions, and qualifications as set forth in this report.

For the purpose of this report, RPA has relied on ownership information provided by Jaguar. RPA has not researched property title or mineral rights for the Turmalina Mine Complex and expresses no opinion as to the ownership status of the property.

RPA has relied on Jaguar for guidance on applicable taxes, royalties, and other government levies or interests, applicable to revenue or income from the Turmalina mining operation.

Except for the purposes legislated under provincial securities laws, any use of this report by any third party is at that party's sole risk.

4 PROPERTY DESCRIPTION AND LOCATION

The Turmalina Mine Complex is located in the state of Minas Gerais approximately 120 km northwest of Belo Horizonte and six kilometres south of Pitangui, the nearest important town (Figure 4-1). The Turmalina Mine Complex is located in the Conceição do Pará municipality.

Jaguar, like other Brazilian mining companies, has large mining concessions, which typically range upwards of 10,000 ha per concession. As a result, a given mine or project may have numerous related mineralized zones extending over many kilometres of strike length, which may eventually have individual mining operations. They may all be grouped under the single mine name, which is often the first operation put into production. To assist in the definition of the location of the primary operation, the geographic coordinates of this primary operation are listed by latitude and longitude. The Turmalina Mine Complex has geographic coordinates of 19°44’36.96” south latitude and 44°52’36.45” west longitude.

MINERAL TENURE

Jaguar acquired the Turmalina Mine Complex from AngloGold in September 2004. Jaguar has 100% ownership subject to a 5% net revenue interest up to $10 million and 3% thereafter, to an unrelated third party. In addition, there is a 0.5% net revenue interest payable to the surface landowner.

The Turmalina Mine Complex comprises a number of contiguous mineral rights holdings granted by the Agência Nacional de Mineração (ANM) that cover an area of 5,034 ha, as summarized in Table 4-1. A summary of mineral royalties is provided in Table 4-2. A summary of the surface rights holdings is provided in Table 4-3. The locations of the mineral rights and surface rights are illustrated in Figures 4-2 and 4-3, respectively.

TABLE 4-1 SUMMARY OF MINERAL RIGHTS HOLDINGS
Jaguar Mining Inc. – Turmalina Mine Complex

ANM Registry No.	Name	Licence Date	Area (ha)	Status
833.584/2012	Zona Basal	16/04/2018	77.87	Exploration Licence (Licence Renewal)
812.003/1975	Casquilho	11/09/1991	980.43	Mining Concession
812.004/1975	Varjao-Pontal e Itamar	04/09/1991	880.00	Mining Concession
803.470/1978	Rio S. João	25/04/1995	952.00	Mining Concession
830.027/1979	Pontal	26/04/1995	120.00	Mining Concession
831.125/2018	Zona Basal	06/09/2018	11.68	Exploration Application
831.126/2018	Zona Basal	06/09/2018	26.13	Exploration Application
831.131/2015	Zona Basal	19/02/2016	131.15	Exploration Licence (Initial)
831.617/2003	Rio S. João	21/07/2010	858.71	Final Exploration Report submitted to ANM
832.203/03	Rio S. João	16/10/2014	996.00	Final Exploration Licence
930.086/2005	Turmalina	26/02/2010		Mining Group
TOTAL			**5,033.97**	

TABLE 4-2 SUMMARY OF MINERAL ROYALTIES, CONCESSION NO. 812.003/1975
Jaguar Mining Inc. – Turmalina Mine Complex

Mineral Rights Royalties

Holder	Royalty	Orebody	Payment Status in BRL	
			Status	Paid in 2018
Eduardo C. de Fonseca	5% of the Production Gross Profits until reaching US$10 million during current fiscal year, then 3% of the Production Gross Profit	A, B and C	Inactive	-
Carlos Andraus / Mirra Empreend. e Participações Ltda.			Active (30%)	1,617,671
Vera A. Di Pace / Vermar Empreend. e Participações Ltda.			Active (30%)	1,617,671
Paulo C. de Fonseca / Sandalo Empreend. E Participações Ltda.			Active (16%)	862,758
Clara Darghan/Mocla Empreend. E Participações Ltda.			Active (12%)	647,068
Eduardo Camiz de F. Junior / Agro Pecuária Aldebaram Empreend. Ltda.			Active (12%)	647,068

Surface Rights Royalties

Holder	Refers to	Orebody	Payment Status in BRL	
			Base Value	Paid in 2018
José Laeste de Lacerda	Surface	A, B and C	6,868	96,485
Wilson Clemente de Faria	Building rent		1,627	115,563
	Surface		6,420	
EPAMIG	Surface	Faina	27,250	327,000
Familia Freitas	Water pipe	A, B and C	2,574	104,772
	Water well		2,143	
	Road access		6,866	

TABLE 4-3 SUMMARY OF SURFACE RIGHTS HOLDINGS
Jaguar Mining Inc. – Turmalina Mine Complex

Name	Registry Number	Location	Area (ha)	Status	20% Area Forest Legal Reserve
FAZENDA CAIAMAL (FAZENDA JOSÉ MARIA, ESPÓLIO)	Mat. R-01-13.321 – Livro 2 – Área: 40 ha / Mat. R-02-5.873 – Livro 2 – Área: 31.5 ha	Tailings Dam (partial)	71.5	Active	The legal reserve of a total of 18.81 ha is in good standing but the registration at the public notary is still pending.
FAZENDA CAIAMAL (FAZENDA BARBIERE)	Mat. 32.288 – Livro 2	Processing Plant, Fill Plant, Tailings Dam and Core shack	96	Active	Legal Reserve is in good standing. Area of 19.50 ha.
FAZENDA IRMÃOS FREITAS (CACA / ANTÔNIO CARLOS ALVES DE FREITAS)	Mat. 30.108 – Livro 2	Orebodies C and D	30	Active	Legal reserve established in name of IBDF (Instituto Brasileiro de Florestas), according to AV – 1 - 30108-03/07/2003, Registration of Legal reserve in name of Jaguar pending.
FAZENDA CASQUILHO (ALEXANDRE FERREIRA DA SILVA)	-	Office, Mess, Mechanic Shop and Decline Portal	3	Active	No Forest legal reserve registered as the area has no more available forest
FAZENDA TANQUE	Pending	Down Dip Projection of Orebodies A & B	25		

0 200 400 600 800 1000
Kilometres

April 2019

Figure 4-1

Jaguar Mining Inc.

Turmalina Mine Complex
Minas Gerais State, Brazil
Location Map

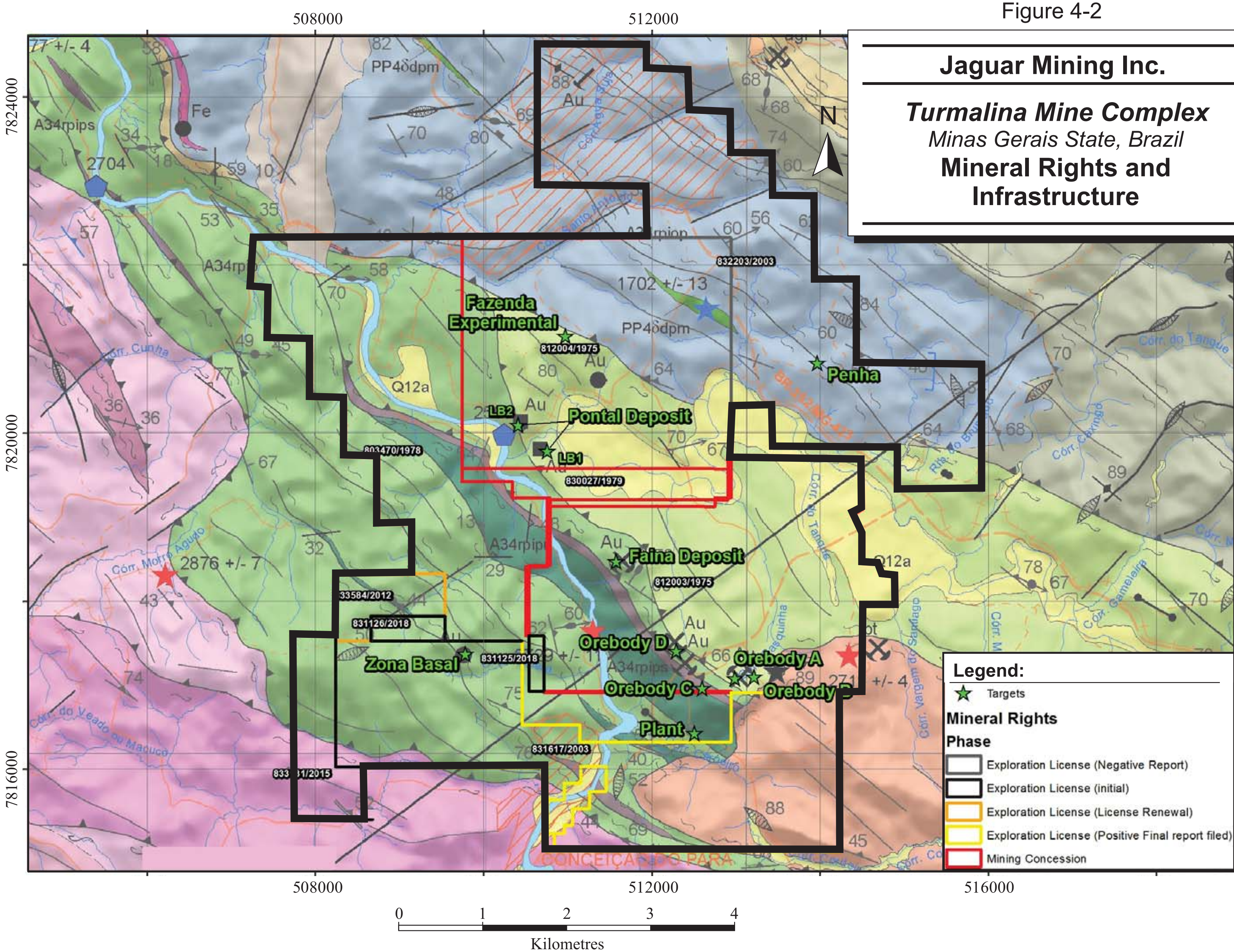
Figure 4-2

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Mineral Rights and Infrastructure



April 2019

Source: Jaguar Mining Inc., 2019.

RPA

www.rpacan.com

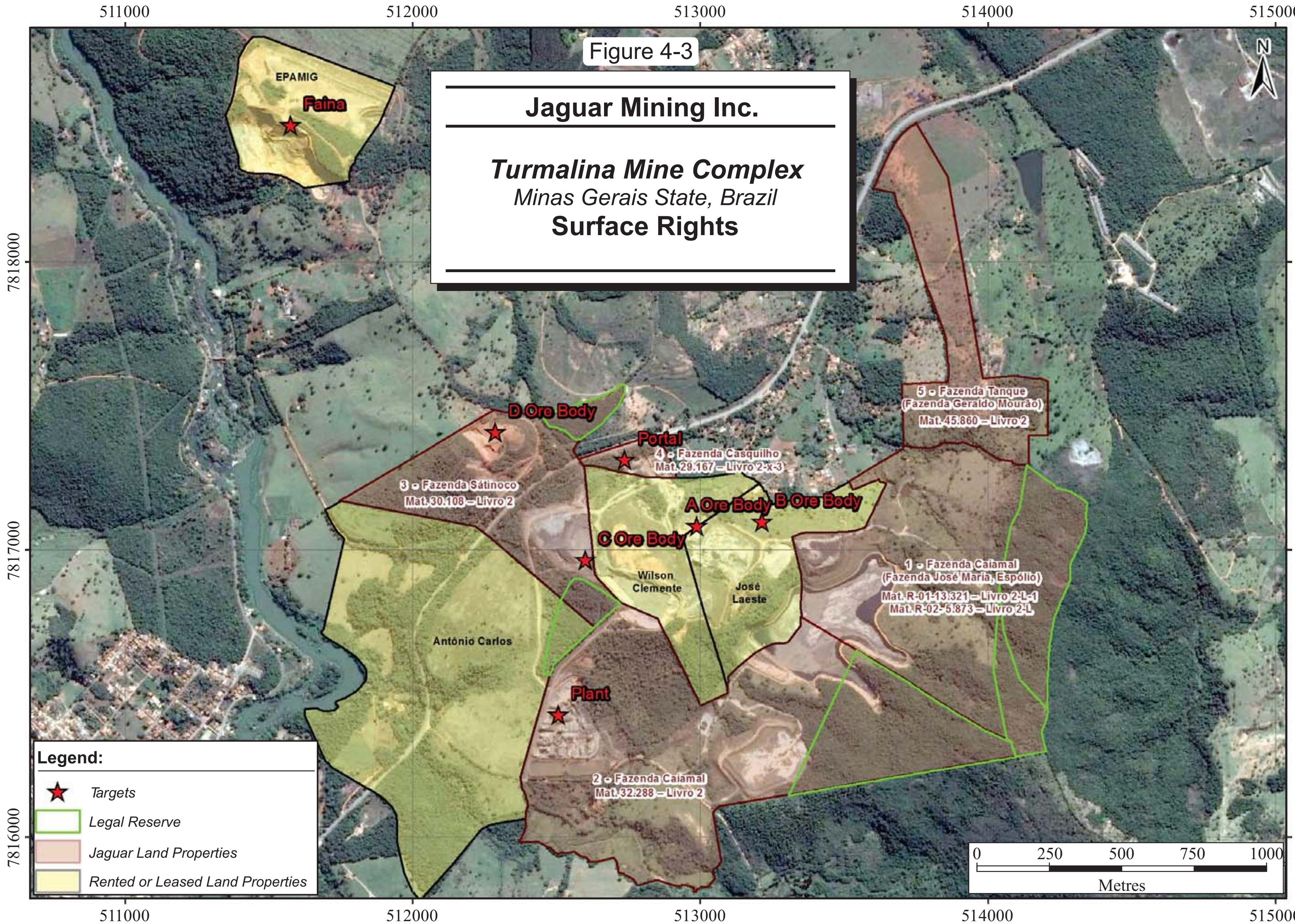
Figure 4-3

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Surface Rights



April 2019

Source: Jaguar Mining Inc., 2016.

MINERAL AND SURFACE RIGHTS IN BRAZIL

In Brazil, the National Department of Mineral Production (Agência Nacional de Mineração, or ANM) issues all mining leases and exploration concessions. Mining leases are renewable annually, and have no set expiry date. Each year, Jaguar is required to provide information to ANM summarizing mine production statistics in order to maintain the mining leases and exploration concessions in good standing.

Exploration concessions are granted for a period of three years. Once a company has applied for an exploration concession, the applicant holds a priority right to the concession area as long as there is no previous ownership. The owner of the concession can apply to have the exploration concession renewed for one-time extension for a period of two or three years. Renewal is at the sole discretion of ANM. Granted exploration concessions are published in the Official Gazette of the Republic (OGR), which lists individual concessions and their change in status. The exploration concession grants the owner the sub-surface mineral rights. Surface rights can be applied for if the land is not owned by a third party.

The owner of an exploration concession is guaranteed, by law, access to perform exploration field work, provided adequate compensation is paid to third party landowners and the owner accepts all environmental liabilities resulting from the exploration work. The exploration permits are subject to annual fees based on its size.

In instances where third party landowners have denied surface access to an exploration concession, the owner maintains full title to the concession until such time as the issue of access is negotiated or legally enforced by the courts. Access is guaranteed under law and the owner of an exploration concession will eventually gain easements to access the concession.

Once access is obtained, the owner has three years to submit an Exploration Report (ER) on the concession. The owner of a mineral concession is obligated to explore the mineral potential of the concession and submit an ER to ANM summarizing the results of the fieldwork and providing conclusions as to the economic viability of the mineralization. The content and structure of the report is dictated by ANM and a person with suitable professional qualifications must prepare the report.

ANM will review the ER for the concessions and will either:

- approve the report provided ANM concurs with the report's conclusions regarding the potential to exploit the mineralization;
- dismiss the report should the report not address all the requirements, in which case the owner is given a term in which to address any identified deficiencies in the report; or
- postpone a decision on the report should it be decided that exploitation of the deposits is temporarily non-economic.

Approval, dismissal, or postponement of the ER is at the discretion of the ANM. There is no set time limit for the ANM to complete the review of the ER. The owner is notified of the ANM's decision on the ER and the decision ID is published in the OGR.

On ANM approval of the ER, the owner of an exploration concession has one year to apply for a mining lease. The application must include a detailed Development Plan (DP) outlining how the deposit will be mined.

ANM reviews the DP and decides whether or not to grant the application. The decision is at the discretion of ANM, but approval is virtually assured unless development of the project is considered harmful to the public or the development of the project compromises interests more relevant than industrial exploitation. Should the application for a mining lease be denied for exploration concessions for which the ER has been approved, the owner is entitled to government compensation.

On approval of the DP, ANM grants the mining licence, which remains in force until the depletion of the mineral resource. Mining concessions remain in good standing subject to submission of annual production reports and payments of royalties to the federal government.

RPA is not aware of any environmental liabilities on the property. Jaguar has all required permits to conduct the proposed work on the property. RPA is not aware of any other significant factors and risks that may affect access, title, or the right or ability to perform the proposed work program on the property.

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

ACCESSIBILITY

The Turmalina Mine Complex is accessed from Belo Horizonte by 120 km of paved highways (BR-262 and MG-423) to the town of Pitangui. The Turmalina deposits are located approximately six kilometres south of Pitangui and less than one kilometre from highway MG-423.

Belo Horizonte is the commercial centre for Brazil's mining industries and has excellent infrastructure to support world-class mining operations. This mining region has historically produced significant quantities of gold and iron from open pit and large-scale underground mining operations operated by AngloGold, VALE, CSN, and Eldorado. The city is a well-developed urban metropolis of almost four million residents and has substantial infrastructure including two airports, an extensive network of paved highways, a fully developed and reliable power grid, and ready access to process and potable water.

Pitangui is a town of approximately 25,000 people. The local economy is based on agriculture, cattle breeding, and a small pig iron plant. Manpower, energy, and water are readily available.

CLIMATE

The Turmalina Mine Complex lies approximately at 700 MASL. The Pitangui area terrain is rugged in places, with numerous rolling hills incised by deep gullies along drainage channels. Farming and ranching activities are carried out in approximately 50% of the region.

The area experiences six months of warm dry weather (April to November) with the mean temperature slightly above 20ºC, followed by six months of tropical rainfall. Annual precipitation ranges from 1,300 mm to 2,500 mm and is most intense in December and January. The climate is suitable for year-round operations.

LOCAL RESOURCES

Belo Horizonte is one of the world's mining capitals with a regional population in the range of 4 million people. Automobile manufacturing and mining services dominate the economy. General Electric has a major locomotive plant which produces engines for all of South America and Africa. Mining activities in Belo Horizonte and the surrounding area have been carried out in a relatively consistent manner for over 300 years. The Turmalina Mine Complex is within commuting distance of Belo Horizonte.

INFRASTRUCTURE

The Turmalina Mine Complex includes a nominal 2,000 tpd processing plant and tailings disposal area. Electrical power is obtained from the national grid.

All ancillary buildings are located near the mine entrance: gate house including a reception area and waiting room, administration building, maintenance shops, cafeteria, warehouse, change room, first aid, and compressor room. The explosives warehouse is located 1.2 km away from the mine area, in compliance with the regulations set forth by the Brazilian Army.

Other ancillary buildings are located near the processing plant and include an office building, a laboratory, warehousing, and a small maintenance shop.

There is no infrastructure related to the Faina and Pontal historic open pit operations.

6 HISTORY

Gold was first discovered in the area in the 17th century, and through the 19th century, intermittent small-scale production took place from alluvial terraces and outcropping quartz veins. Gold production exploited alluvium or weathered material, including saprolite and saprolite-hosted quartz veins. Records from this historical period are few and incomplete.

AngloGold controlled the mineral rights from 1978 to 2004 through a number of Brazilian subsidiaries. AngloGold explored the Turmalina Mine Complex area extensively between 1979 and 1988 using geochemistry, ground geophysics, and trenching, which led to the discovery of the Turmalina, Satinoco (Orebody C), Faina, and Pontal deposits, and other mineralized zones. Initial exploration work at the what would become Orebody A included 22 surface-based diamond drill holes totalling 5,439 m to test the downward extension of the sulphide mineralized body. At the Satinoco target (Orebody C), a total of 1,523 m were completed in nine holes.

In 1992 and 1993, AngloGold mined 373,000 t of oxide ore from open pits at the Turmalina, Satinoco (now referred to as Orebody C), Pontal, and Faina zones. It recovered 35,500 oz of gold using heap leach technology. Subsequently, AngloGold drove a ramp beneath the Turmalina pit and carried out drifting on two levels in the mineralized zone at approximately 50 m and 75 m below the pit floor to explore the downward extension of the sulphide mineralized body.

Jaguar acquired the AngloGold Turmalina properties in 2004 and continued operation of the underground mine. The mine is accessed from a 5 m by 5 m primary decline located in the footwall of the main deposit. As at December 31, 2018 the decline has reached Level 12, at a vertical depth of approximately 875 m below surface.

HISTORICAL RESOURCE ESTIMATES

RPA is not aware of any historical Mineral Resource estimates prepared by previous owners of the land holdings.

PAST PRODUCTION

. In 2018, the Turmalina plant processed approximately 322,000 tonnes at an average feed grade of 3.44 g/t Au to produce 35,630 ounces of gold. In total, the plant has processed approximately 6.2 million tonnes of ore to produce a total of approximately 672,000 ounces of gold at an average recovered grade of 3.56 g/t Au (Table 6-1). This production includes a small quantity of material that was processed prior to Jaguar's ownership, the sulphide material extracted by Jaguar from Orebodies A, B, and C, and the oxide portions of the Orebody D, Faina, and Pontal deposits that were amenable to treatment at the existing plant.

Production from the Faina deposit open pit mine took place intermittently over a three year period between June 2010 and June 2013.

TABLE 6-1 PRODUCTION HISTORY AND MILL RECOVERY
Jaguar Mining Inc. – Turmalina Mine Complex

Year	Tonnes Milled (000)	Feed Grade (g/t Au)	Recovered Grade (g/t Au)	Recovery (%)	Gold Produced (oz)
1992-1993	373		2.96		35,500
Q4 2006	9	2.58		91.5	678
2007	347	5.08	4.37	86.6	44,515
2008	481	5.46	5.37	88.5	72,514
2009	588	4.81	4.29	89.1	73,589
2010	692	3.20	3.06	87.4	61,860
2011	655	3.32	3.27	89.2	61,676
2012	473	2.48	2.13	89.2	37,840
2013	457	3.24	2.85	88.7	43,424
2014	442	3.69	3.27	90.0	47,993
2015	406	4.14	3.87	91.0	50,658
2016	502	3.89	3.92	91.5	63,258
2017	427	3.48	3.17	91.0	45,466
2018	322	3.44	3.12	90.7	33,261
Total	**6,174**	**3.82**	**3.56**		**672,232**

7 GEOLOGICAL SETTING AND MINERALIZATION

REGIONAL GEOLOGY

The Turmalina deposits are located in the western part of the Iron Quadrangle, which has been the largest and most important mineral province in Brazil for centuries until the early 1980s, when the Carajás mineral province, in the state of Pará, attained equal status. Many commodities are mined in the Iron Quadrangle, the most important being gold, iron, manganese, bauxite, imperial topaz, and limestone. The Iron Quadrangle was the principal region for the Brazilian hard rock gold mining until 1983 and accounted for about 40% of Brazil's total gold production. Gold was produced from numerous deposits, primarily in the northern and southeastern parts of the Iron Quadrangle, most hosted by Archean or Early Proterozoic-aged banded iron formations (BIF) contained within greenstone belt supracrustal sequences.

In the Brumal region, outcrops belonging to the granitic gneiss basement of the Nova Lima and Quebra sub-groups of the Rio das Velhas Supergroup occur. The granitic gneiss basement consists of leucocratic and homogeneous gneisses and migmatites, making up a complex of an initial tonalitic composition intruded by Archean rocks of granitic composition. The upper contact of the sequence is discordant and tectonically induced by reverse faulting. The Rio das Velhas is regionally represented by schists of the Nova Lima and meta-ultramafic rocks of the Quebra Group including serpentinites, talc schists, and metabasalts.

Iron formations occur as the only meta-sedimentary rocks in layers with thicknesses up to 10 m. The Nova Lima Group can be sub-divided into two units: a unit consisting of talc chlorites and intercalations of iron formation, fuchsite schist, quartz sericite schist, and carbonaceous phyllite; and a unit hosting sulphidized gold bearing iron formation and quartz sericite schists.

The regional geology is shown in Figure 7-1.

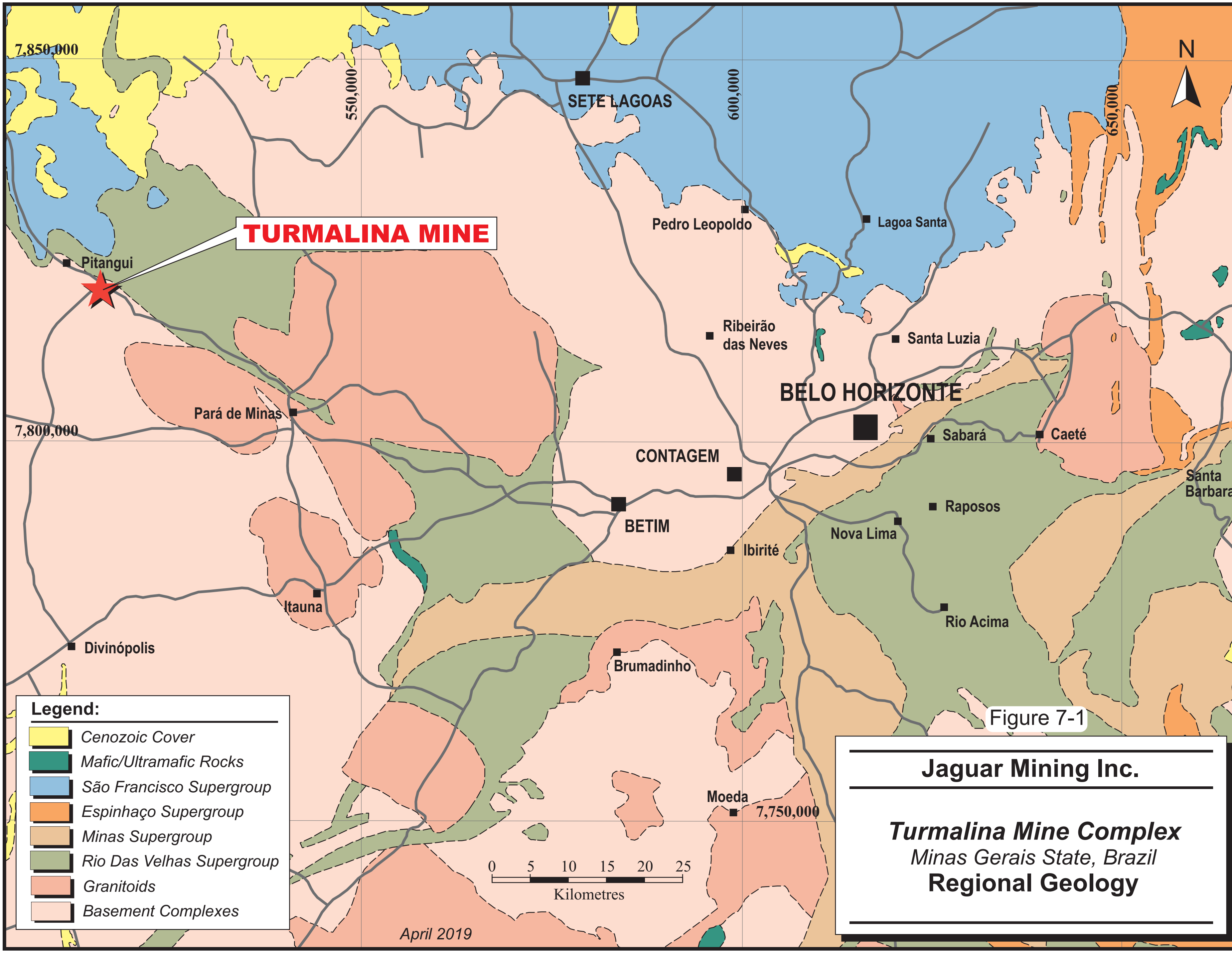


Figure 7-1

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Regional Geology

www.rpacan.com

LOCAL GEOLOGY

The Pitangui area, where the Turmalina Mine Complex is located, is underlain by rocks of Archaean and Proterozoic age. Archaean units include a granitic basement, overlain by the Pitangui Group, a sequence of ultramafic to intermediate volcanic flows and pyroclastics and associated sediments. The Turmalina deposit is hosted by chlorite-amphibole schist and biotite schist units within the Pitangui Group. A sequence of sheared, banded, sulphide iron formation and chert lies within the stratigraphic sequence. The stratigraphy locally strikes azimuth 135º.

Proterozoic units include the Minas Supergroup and the Bambui Group. The former includes basal quartzites and conglomerates as well as phyllites. Some phyllites, stratigraphically higher in the sequence, are hematitic. The Bambui is composed of calcareous sediments.

The local geology in the Turmalina Mine Complex and adjacent exploration areas was defined by AngloGold, specifically by UNIGEO geologists during the initial exploration field work. At that time, the mapped lithologies were defined and classified as a greenstone sequence, within a possible western extension of the Iron Quadrangle.

The stratigraphic column defined by UNIGEO in the region, from bottom to the top was:

BASEMENT

The basement is composed of foliated, leucocratic granite and gneisses. Locally, it has been defined as migmatite portions with porphyry crystals of quartz and K- feldspars. Granitic intrusions with fine to medium texture and diabase dikes are common.

PITANGUI GROUP

The Pitangui Group is defined as a greenstone belt sequence, of Archean age. It shows the following sequence:

- Meta-Ultramafic and Meta-Mafic Volcanic Unit (Basal Unit): constituted by interlayered igneous ultramafic and mafic flows represented by serpentinite, chlorite-actinolite schist and amphibolite with layers of talc schist, oxide BIF and carbonaceous schist;

- Meta-Mafic and Meta-Sediment Unit (Middle Unit): constituted by interlayered meta-mafic (chlorite-actinolite schist with dacitic intrusion at the top);

- Meta-sediment: cummingtonite BIF and meta-chert rich horizons interlayered with carbonaceous and chlorite schist, locally, layers of meta-arkose can be observed);

- Meta-mafic: alternation of amphibolite and chlorite-actinolite layers;
- Pyroclastic and meta-pelites: volcanic meta-conglomerates at the bottom, transitioning to or alternating with foliated meta-lapilli tuffs and meta-tuffs at the top of the sequence, where the meta-tuffs are predominant;
- Meta-sediments (Upper Unit): narrow and numerous interlayered layers of quartz-sericite schist, quartz-chlorite schist, quartz-sericite-chlorite schist, and carbonate-rich schist.

MINAS SUPERGROUP

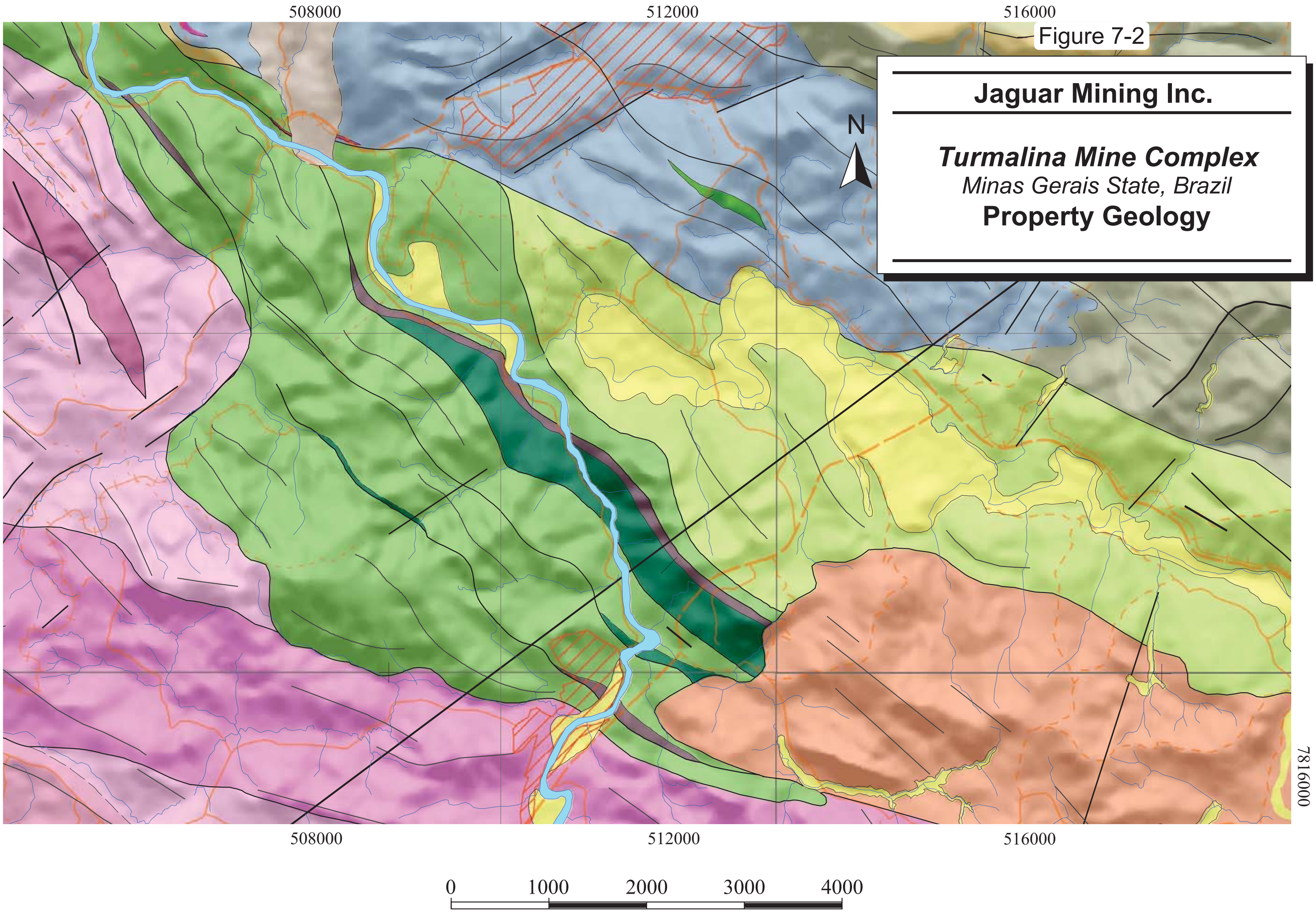
The Minas Supergroup is defined as clastic and chemical sediments in a Proterozoic sequence composed by thin to coarse quartzites with layers of the basal conglomerates. The quartzite is covered by grey carbonate phyllites and white sericite phyllites which present hematite increasing to the top of the sequence.

INTRUSIVE ROCKS

The intrusive rocks are defined as granitic and mafic to ultramafic rocks.

PROPERTY GEOLOGY

The details of the property geology of the Turmalina Mine Complex area are shown in Figure 7-2. The general stratigraphic sequence strikes towards azimuth 320° and dips moderately to steeply to the east. The sequence consists the Pitangui Group of bedded metasediments of volcanic origin including quartz-sericite schists and sericite-chlorite-biotite schists grading stratigraphically upwards into a meta-chert, BIF and graphitic schist. Overlying these sediments is a thicker sequence of tuffaceous metasediments and quartz-chlorite schists. All units have been metamorphosed to the amphibolite grade.



Legend Provided Figure7-2A.

April 2019

Source: Jaguar Mining Inc., 2016.

FANEROZOICO - CENOZOICO

Q12a Depósitos aluvionares inconsolidados e terraços aluvionares semi-consolidados. Compostos pela intercalação de sedimentos arenosos, cascalhosos e síltico-argilosos.

Ndl Coberturas eluvionares detrito-lateríticas compostas por seixos e matacões de quartzo e/ou com cobertura parcial de carapaça limonítica.

NEOPROTEROZOICO

GRUPO BAMBUÍ

Formação Serra de Santa Helena

NP3bsh Siltitos e argilitos cinzentos com lentes de marga calcítica verde a cinzenta na base. Ocorrem lentes métricas de arenitos finos.

Formação Sete Lagoas

NP2bsl Calcarenitos, calcissiltitos, dolarenitos, dolossiltitos e margas.

Formação Carrancas

NP1bcr Argilitos com intercalações de camadas ou lentes vermelhas ferruginosas e lentes pretas carbonosas, associados a ritmitos carbonáticos formados por intercalações entre lâminas siltosas e silto-arenosas com laminações plano-paralelas e onduladas, e estratificações cruzadas dos tipos hummocky e tabular.

NP1bcd Diamictitos compostos por clastos angulosos a arredondados de quartzitos, granitoides, gnaisses, xistos quartzosos e dolomitos. A matriz é arenosa e aumenta em proporção para o topo.

PALEPROTEROZOICO

PP4δdpm Corpos de diabásio de granulação média e textura subofítica, localmente com fenocristais de feldspato sericitizado de até 10cm (1.702 +/- 13Ma, U-Pb).

Formação Fazenda Tapera

PP2ftg (p) Metagrauvacas e arenitos arcoseanos com fragmentos de microclina, filito, metachert e rochas metavulcânicas félsicas e máficas com subordinados metarritmitos finos com predomínio de lâminas pelíticas, alternadas com lâminas arenosas (p).

PP2ftp (lp, g, c) Metarritmitos finos com predomínio de lâminas pelíticas, alternadas com lâminas arenosas (2125 Ma, U-Pb, idade máxima de sedimentação), além de intercalações subordinadas de feldspato-sericita-quartzo filito (metatufos félsicos de queda) e lentes de metagrauvacas finas (g). Sericita-quartzo filito com grânulos elípticos e estrutura interna zonada que correspondem a lapilli acrescionários (lp), típicos de tufos félsicos de cinza ou de queda. Meta-chert (c) de granulação fina a média com minerais opacos disseminados.

Corpos de posicionamento incerto

APgb Diques de gabro

APmβ Biotita-clorita-quartzo filito (rocha metabásica).

APλ Episienito vermelho a róseo de granulação média a grossa.

APanf Anfibolito preto a esverdeado de textura granonematoblástica equigranular média a grossa, por vezes granatífero, podendo ter aspecto bandado ou mosqueado. Ocorrem sob a forma de pequenos corpos com direção preferencial NW-SE e têm como protólito rochas metabásicas.

APdb Diques de diabásio de textura subofítica fina, composta por plagioclásios tabulares a ripformes, piroxênio e Ti-magnetita e minerais de alteração (clorita, tremolita-actinolita, epidoto e sericita). Pode apresentar vesículas circulares de até 2mm de diâmetro preenchidas por clorita e carbonato.

Unidade Serra dos Ferreiras

APsf (a, m) Zona de alteração hidrotermal sericítica, com presença local de cloritoide. Em termos litológicos correspondem a intercalações de (cloritoide)-quartzo-muscovita xisto, (cloritoide)-muscovita-quartzo xisto e, subordinadamente, quartzito muscovítico, por vezes ferruginoso. Localmente, ocorrem níveis restritos de metaconglomerados, filitos carbonosos e magnetititos ou hematititos. Magnetititos e hematititos também ocorrem em corpos ou veios, associados ou não a brechas com matriz de magnetita, martita ou hematita (m). Zona de alteração peraluminosa (agalmatolito), pirofilita xisto, pirofilita-quartzo fels, (andaluzita-cianita-coríndon)- pirofilita-diásporo xisto, muscovita-pirofilita xisto,cianitito, diasporito, pirofilitito. Tais rochas apresentam halos hidrotermais com teores variáveis de cloritoide, sericita e caulinita (a).

NEOARQUEANO

Magmatismo cálcio-alcalino de alto K

A4γ3cp Plúton Conceição do Pará: biotita-granito leucocrático e isotrópico, de granulação média a grossa.

A4γ3gc Plúton Casquilho: biotita-granito leucocrático de granulação média a grossa, localmente foliado (2.711+/-4Ma,U-Pb LA-ICP-MS).

A4γ3ca Granito Córrego do Arruda: biotita monzogranitos com granodioritos subordinados de granulação média a grossa, comumente porfiríticos, com fenocristais de microclina centimétricos. Apresentam textura protomilonítica a milonítica e assinatura geoquímica cálcio-alcalina de alto potássio.

Magmatismo cálcio-alcalino de médio K / TTG

A4γ3fs Batólito Serra dos Tavares: trondjemitos e granodioritos com leucogranitos subordinados, de granulação média a grossa, localmente foliados, portando biotita cloritizada. (2.755 +/- 8 Ma, U-Pb LA-ICP-MS).

A4γ3mp Batólito Pequi: (sillimanita)-biotita granodiorito a tonalito de granulação média a grossa, localmente porfirítico. São comuns diques de anfibolito associados (2.750 +/- 13 Ma, U-Pb LA-ICP-MS).

A4γ3fj Plúton Jaguara: biotita granito de granulação média a grossa, localmente portando fenocristais de feldspato alcalino (2.747 +/- 7 Ma, U-Pb LA-ICP-MS).

Suíte Intrusiva Mato Dentro (2.755 +/- 13 Ma, U-Pb zircão)

A4γ2 (p, co, sa) Biotita-granodioritos a monzogranitos de granulação média a grossa, localmente porfiríticos. Plútons Pará de Minas (A4γ2p), Serra do Andaime (A4γ2sa) e Coqueiro (A4γ2co).

SUPERGRUPO RIO DAS VELHAS

Formação Antimes

A4ra Quartzitos puros a micáceos de granulometria fina a grossa, com níveis de metaconglomerados polimíticos suportados pelos clastos, com grãos arredondados a angulosos e matriz arenosa (2684 Ma, U-Pb, idade máxima de sedimentação). Os clastos são compostos por quartzo de veios, metachert, filitos diversos e metamáficas. Localmente, ocorrem intercalações de metapelitos, e por vezes, lentes hidrotermais estão associadas. Na base da unidade são observadas brechas com matriz ferruginosa.

GRUPO PITANGUI

Formação Onça do Pitangui

A34rpiop (ff, cg) Metarritmito com intercalações milimétricas a centimétricas de filito sericítico de granulometria argila a silte (metapelito), ora carbonoso ora ferruginoso, e sericita-feldspato-quartzo filito de granulometria areia fina (metagrauvaca feldspática), com predominância do primeiro. Ocorrem intercalações de metachert ferruginoso e formação ferrífera bandada (ff), meta-arenitos e metaconglomerados (cg), contendo grãos e fragmentos de feldspato, quartzo, quartzo fumê, metachert e metachert ferruginoso. Por vezes ocorrem lentes hidrotermais associadas.

A34rpiog (ff) Intercalações de filito sericítico e filito carbonoso (metapelitos) com (clorita)-carbonato-plagioclásio-quartzo-sericita filito (metagrauvaca feldspática a lítica) (2788 Ma, U-Pb idade máxima de sedimentação) e meta-arcóseos a meta-arenitos líticos de granulometria fina a média. Ocorrem subordinadamente metachert e formação ferrífera bandada (ff), metabrechas monomíticas a polimíticas, suportadas por matriz sericítica, e contendo clastos de metachert e feldspato-sericita-quartzo filito. A unidade possui bandamento rítmico bem desenvolvido, com espessura milimétrica a métrica, e diferentes graus de carbonatação (Fe-carbonato).

Formação Rio São João

A34rpis (ff) Metarritmitos com intercalações com níveis de quartzo-biotita xisto, (carbonato-clorita)-biotita-quartzo filito (metapelitos), clorita-biotita-plagioclásio-(carbonato)-quartzo xisto (metarenitos arcoseanos), biotita-clorita-plagioclásio-quartzo-actinolita xisto com bandamento rítmico centimétrico a decimétrico. Ocorrem intercalações subordinadas de plagioclásio-actinolita xisto (metabasalto) e clorita-talco xisto (metavulcânica ultramáfica), metachert, formação ferrífera bandada (ff), e quartzitos, além de metabrechas polimíticas suportadas por matriz biotítica a clorítica, contendo clastos líticos de clorita xistos, filitos sericíticos, metachert e possíveis litoclastos de rochas metavulcânicas máficas e intermediárias.

Formação Rio Pará

A34rpips Intercalações de (clorita)-sericita-cloritoide-quartzo xisto, cloritoide-quartzo-clorita xisto (metapelitos aluminosos e ferruginosos), filito sericítico, filito carbonoso, metachert, metachert ferruginoso, formações ferríferas bandadas, sericita-quartzo xisto a quartzito sericítico (metapelitos a metarenitos), feldspato-sericita-quartzo-xisto (metagrauvaca feldspática vulcanoclástica) (2877+/-4 Ma, U-Pb discórdia), metabrecha e metaconglomerado polimíticos.

A34rpip (ff) Intercalações de plagioclásio-actinolita xisto, plagioclásio-actinolita fels (carbonato-epidoto-clorita)-plagioclásio-actinolita xisto (metabasaltos com afinidades komatiítica a tholeítica de alto-Mg e alto Fe) e quartzo-plagioclásio-(actinolita)-biotita-clorita xisto, quartzo-clorita xisto e subordinadamente clorita-augita-hornblenda metagabro com afinidade tholeítica de alto-Mg (2729 Ma, U-Pb discórdia) e rochas metaultramáficas. Localmente as rochas metavulcânicas exibem estruturas almofadadas, textura variolítica e níveis de peperito. Ocorrem também intercalações decimétricas a métricas de formações ferríferas bandadas (ff), metacherts, quartzitos, filitos carbonosos e (clorita)-biotita-quartzo xisto, biotita-clorita-plagioclásio-actinolita-quartzo xisto, carbonato-biotita-plagioclásio -quartzo xisto (meta-renitos ou metagrauvacas feldspáticas), (2842+/- 22 Ma, U-Pb idade máxima de sedimentação).

A34rpipu Intercalações de (magnetita)-talco-xisto, (antofilita)-clorita-talco-xisto, serpentina-talco-magnetita-tremolita-clorita fels (metavulcânicas ultramáficas) com rochas metamáficas, filito sericítico a carbonoso e metachert subordinados.

MESOARQUEANO

Complexo Divinópolis

A3dm (Anfibólio)-biotita gnaisse migmatítico de composição granítica e granulação média a grossa, com estruturas bandada e estromática. Subordinadamente ocorrem também as estruturas schollen, schlieren, flebítica e nebulítica. Podem ocorrer corpos de neossoma compostos por quartzo e feldspato róseo de granulação grossa. Estes gnaisses são intrudidos por corpos não individualizados de granitos de granulação fina a média.

A3dg Leucognaisses ortoderivados de granulação fina a média, com evidências de fusão parcial incipiente e presença de intrusões de granitoides de granulação fina a média.

Figure 7-2A

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Property Geology Legend

April 2019

Source: Jaguar Mining Inc., 2019.

MINERALIZATION

The mineralization at the Turmalina deposit consists of a number of tabular bodies that are spatially related to a BIF. These tabular bodies are grouped together according to spatial configuration and gold content into Orebodies A, B, and C (together the Orebodies). Gold can occur within the BIF itself, but can equally occur in the other host lithologies.

The main production of the mine has been from Orebody A, which is mostly comprised of a folded (?), steeply northeast dipping tabular deposit with a steep southeasterly plunge. A number of additional tabular mineralized zones occur in close spatial relationship and generally sub-parallel to this main folded zone. The majority of the gold grades are hosted by a biotite schist host rock. The mineralization in this deposit has been outlined along a strike length of approximately 250 m to 300 m and to depths of approximately 1,100 m to 1,150 m below surface.

Orebody B includes two lower grade, tabular-shaped lenses that are generally parallel to Orebody A. Two of the lenses are located approximately 50 m to 75 m in the structural hanging wall and are accessed by a series of cross-cuts that are driven from Orebody A in the upper levels of the mine. The third lens is located possibly along the axial plane. The mineralization in this deposit has been outlined along a strike length of approximately 350 m to 400 m and to depths of 650 m to 700 m below surface.

Orebody C is a series of 26 tabular lenses that are located to the west in the structural footwall of Orebody A and are generally oriented parallel with Orebody A. They strike northwest and dip steeply to the northeast. A relatively minor amount of production has been achieved from these lenses to date. However, recently completed drilling programs have been successful at outlining additional gold mineralization along the down-dip projection of some of these lenses such that an increasing amount of gold production from these lenses. The mineralization in this deposit has been outlined along a strike length of approximately 1,200 m to 1,250 m and to depths of 850 m to 900 m below surface.

Gold mineralization in the Turmalina deposits occurs in fine grains associated with sulphides in sheared/foliated schists and BIF sequences. Gold particles average 10 µm to 20 µm and are mostly associated with arsenopyrite, quartz, and micas (sericite and biotite) as presented in Table 7-1.

TABLE 7-1 GOLD MODE OF OCCURRENCE
Jaguar Mining Inc. –Turmalina Mine Complex

Associated with:	% of Gold Content	Notes
Arsenopyrite	61	Occurring both inside and at the borders of the mineral
Quartz	26	Occurring both inside and at the borders of the mineral
Micas	9	Occurring both inside and at the borders of the mineral
Pyrite + Pyrrhotite	4	Occurring only at the borders of the mineral

Coarse gold, on a millimetre scale, is found locally with discrete quartz veins, but this type of occurrence is minor.

The style of mineralization is similar at the Faina and Pontal deposits with the exception that metallurgical testing has discovered that the mineralization at those two deposits is refractory with respect to the current plant configuration.

8 DEPOSIT TYPES

The gold metallogeny in the Iron Quadrangle is complex. Three types of deposits are the major sources for gold in the region. Initially, during the deposition of the Archean Nova Lima Group greenstone belt rocks, sea floor volcanic exhalative processes produced BIF and chert that hosted sulphide-rich, gold-bearing deposits of syngenetic origin. Subsequently, these greenstone belt rocks were deformed and mesothermal shear zone-related gold deposits were formed. Most of the gold produced from the Iron Quadrangle has come from these first two deposit types. The third type of gold deposit is hosted by silicified and carbonatized schist within shear zones.

The deposits at the Turmalina Mine Complex are believed to be typical examples of mesothermal, epigenetic deposits that are enclosed by host rocks that have undergone amphibolite-grade metamorphism.

9 EXPLORATION

GEOCHEMISTRY

AngloGold performed a regional geochemistry survey covering an area of 430 km^2 in the Turmalina region. A total of 875 stream sediments and 446 pan concentrate samples were collected. Stream sediment samples were assayed for Au, Cu, Zn, Pb, Cr, Sb, and As. Pan concentrate samples were assayed for Au only.

Soil geochemistry sampling was executed by AngloGold in both the Faina and Pontal areas with grids varying from 100 m x 20 m to 10 m x 10 m. At Faina, 1,272 soil samples were collected and 16,900 m of lines were opened. At Pontal, 1,698 soil samples were collected and 28,000 m of lines were opened.

Several samples returned gold grades superior to 300 ppb. A significant portion of the soil samples collected from these targets were also assayed for As and Sb. There is a strong relation between gold and As/Sb since gold is associated directly with quartz veins with arsenopyrite and/or berthierite in the region.

Initial exploration efforts by Jaguar in 2004 focused on the re-interpretation of the AngloGold data (trenches, soil geochemistry, and drilling) to better understand the local geology. These efforts were concentrated on the targets previously identified by AngloGold.

An exploration program was carried out at the Satinoco (Orebody C) target by Jaguar from March 2006 to April 2008 in order to collect sufficient information to prepare an estimate of the Mineral Resources in accordance with NI 43-101. This program included the opening of about 700 m of trenches and the collection of 146 channel samples crossing the mineralized zone and a complementary diamond drill program.

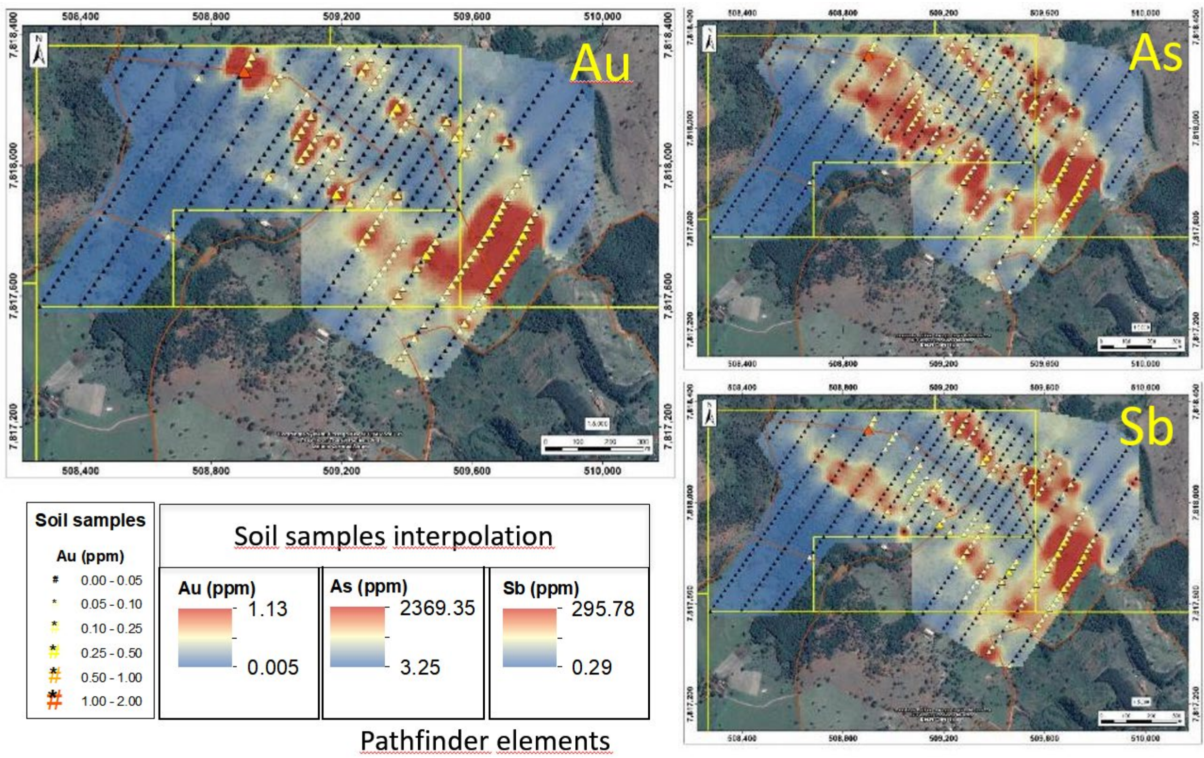
Jaguar carried out a program of soil sampling, chip sampling, trenching, and geological mapping in 2018 on the Zona Basal target, located approximately four kilometres to the west of Orebodies A and C.

The soil sampling program involved the collection of 670 soil samples from the B-horizon which were analyzed for gold and 48 elements by the ALS Chemex laboratory located in Vespasiano. This soil sampling program was carried out along a series of 12 sampling lines that were spaced approximately 50 m apart. The soil sampling program detected the presence of two gold anomalies that were oriented in a northwest-southeast direction, roughly parallel to the regional stratigraphic trends. The gold anomalies contained elevated values of arsenic and antimony (Figure 9-1). Detailed mapping in the area of the soil anomalies found several small gossanous outcrops where grab samples yielded grades between 1.38 g/t Au and 26.5 g/t Au (Table 9-1).

TABLE 9-1 SUMMARY OF CHIP AND GRAB SAMPLE RESULTS, ZONA BASAL TARGET
Jaguar Mining Inc. –Turmalina Mine Complex

Sample ID	Soil Sample ID	Lithology	Au (ppm)	Ag (ppm)	As (ppm)	Sb (ppm)
LZB0184	SZB1745	FF	26.50	1.58	933	16.3
LZB0185	SZB1744	VQZ	2.72	0.08	87	6.49
LZB0197		FF	2.61	0.5	2830	48.1
LZB0198		FF	1.38	0.39	2290	63.3
LZB0209	SZB1846	FF	0.72	0.14	2420	29.1
LZB0058	SZB1889	VQZ	0.56	0.14	354	16.55
LZB0195	SZB1804	FF	0.47	0.13	1170	34
LZB0203		FF	0.28	0.08	1395	40
LZB0215	SZB1837	MCH	0.26	0.25	201	13.4
LZB0047	SZB1757	VQZ	0.25	0.09	871	235

FIGURE 9-1 RESULTS OF 2018 SOIL SAMPLING SURVEY

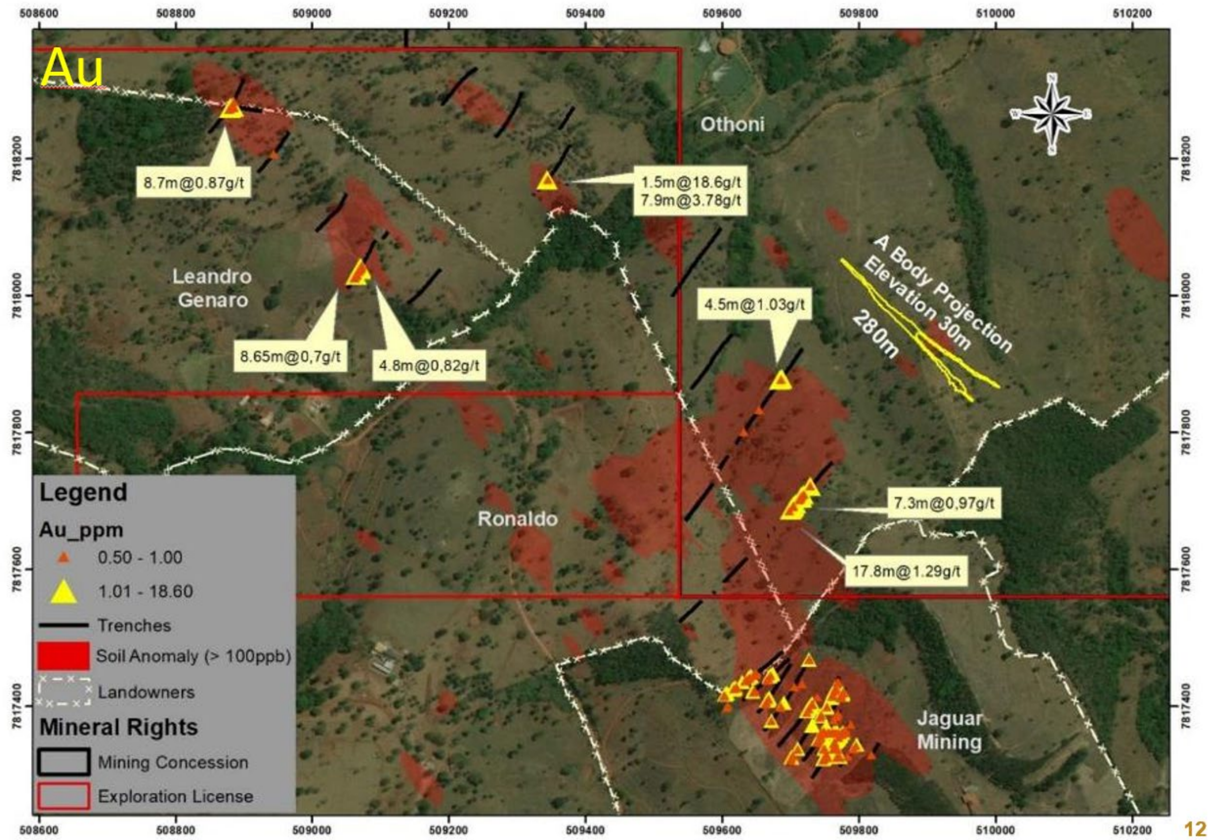


A total of 14 trenches were excavated totaling 1,434 m in length. These trenches were geologically mapped and samples taken of any material that was believed to contain gold mineralization. A total of 1,055 channel samples were taken and the results are presented in Table 9-2. The location of the trenches is shown in Figure 9-2.

TABLE 9-2 SUMMARY OF CHANNEL SAMPLE RESULTS, ZONA BASAL TRENCHES
Jaguar Mining Inc. –Turmalina Mine Complex

Trench	Composite
TZB034	8.65m@0.70g/t
TZB034	4.80m@0.82g/t
TZB037	8.70m@0.87g/t
TZB041	17.80m@1.29g/t
TZB041	7.30m@0.97g/t
TZB042	4.50m@1.03g/t
TZB047	1.50m@18.60g/t
TZB047	7.90m@3.78g/t

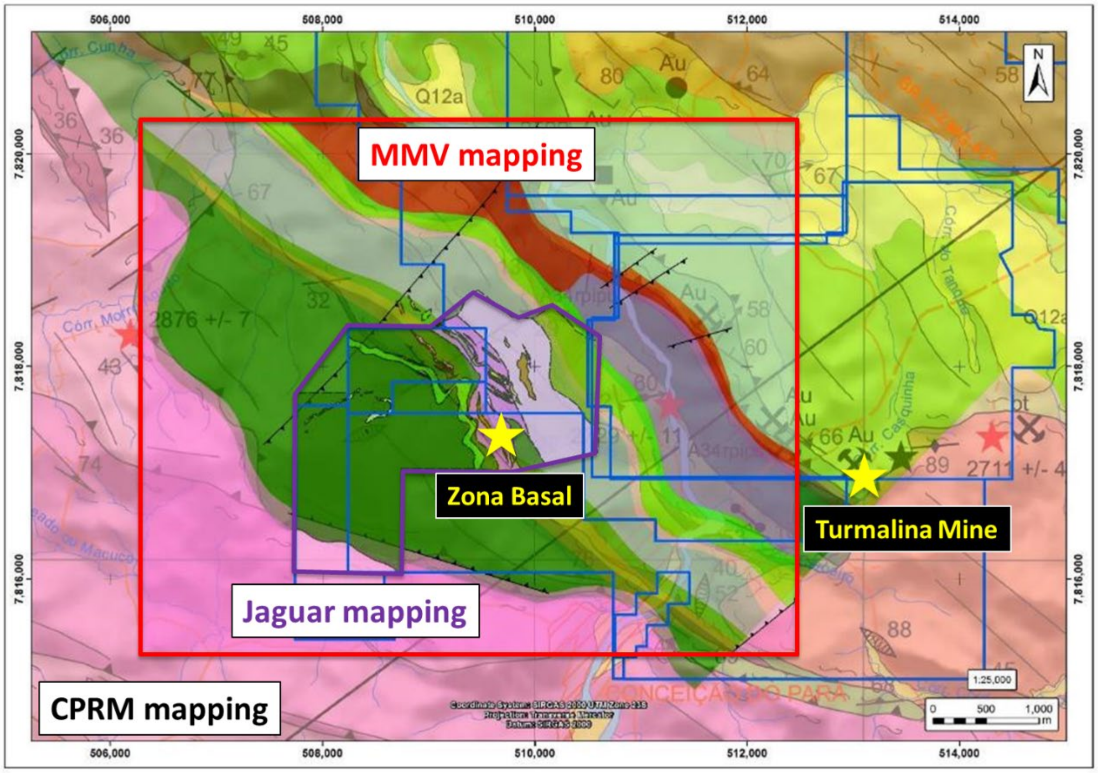
FIGURE 9-2 2018 TRENCH LOCATIONS AND CHANNEL SAMPLING RESULTS, ZONA BASAL TARGET



Geological mapping was carried out by Jaguar's exploration team over an area of approximately 78 ha at a scale of 1:2,500 (Figure 9-3). This mapping program discovered numerous occurrences of rock outcroppings, mostly located along the various drainage features in the area.

It is clear that the exploration program carried out over the Zona Basal target has discovered gold mineralization over an area measuring approximately 1,000 m to 1,250 m along strike and approximately 500 m across strike. This area was not previously considered as having potential for hosting potentially economic mineralization. RPA agrees with Jaguar's view that the results obtained from the Zona Basal target area merit further examination by means of a preliminary diamond drilling program. In RPA's opinion, the soil sampling and geological mapping programs should be extended along the southwestern projection of the Zona Basal stratigraphy to search for the presence of additional gold-bearing mineralization in this area.

FIGURE 9-3 AREA OF 2018 GEOLOGICAL MAPPING, ZONA BASAL TARGET



GEOPHYSICAL SURVEYS

In the 1980s, AngloGold contracted the *Instituto de Pesquisas Tecnológicas* (IPT) to execute a ground geophysics survey at the Faina and Pontal deposit areas. At the Faina deposit, a 50 m x 100 m grid was created composed of 11 lines covering about 31.5 ha. At the Pontal deposit, the grid was 40 m x 100 m in size, with 24 lines covering about 130 ha. Part of this area (approximately 56 ha) was surveyed by ground magnetics in a 5 m x 25 m grid.

Several geophysical anomalies were defined by both methods and most of them showed a strong relation with the geochemical anomalies. This information was used for the planning of trench locations.

In 2004, the Minas Gerais Government Mining Agency (COMIG) completed a supplementary airborne geophysical survey, covering all the Iron Quadrangle and the adjacent areas, totaling approximately 36,400 km^2. This survey was performed by LASA SA on a 250 m grid using magnetic and gamma ray methods. All Jaguar targets, including the Turmalina deposit, were covered with these geophysical surveys.

10 DRILLING

Following the trenching and channel sampling program between March 2006 and April 2008, Jaguar completed a three-phase drilling campaign in the Turmalina Mine area:

Phase 1: 5,501 m drilled in 35 holes. This program tested the continuity of the mineralized bodies between the weathered zone and up to 200 m below the surface.

Phase 2: 3,338 m drilled in 24 complementary in-fill holes to create a 25 m x 60 m grid between the surface and 100 m below and to test the lateral continuity of the mineralized bodies.

Phase 3: An additional drill hole campaign was carried out in 2007, which consisted of 12,763 m drilled in 48 holes. Results from holes FSN 10 to 68 from this campaign were included in the mineral resource estimate contained in the original TechnoMine technical report, dated October 22, 2007. Results from the remaining drill holes FSN 69 to 113 were included in the second TechnoMine technical report dated February 5, 2008.

During the three Satinoco/Orebody C drilling phases, 2,338 core samples from holes FSN 10 to 113 were collected. The drill program was carried out by Mata Nativa Comércio e Serviços Ltda. (Mata Nativa), a local drilling company, using Longyear drill machines.

Drill hole lengths ranged from 32 m to 453 m. Core diameters were consistently HQ (63.5 mm) from surface through the weathered rock to bedrock. At approximately three metres into bedrock, the holes were reduced to NQ (47.6 mm) diameter to the final depth.

Collar locations for the holes were established by theodolite surveys. All holes were drilled within three metres of the planned location. Azimuth and inclination for angle holes were set by Brunton compass, deemed accurate to within 2° azimuth and <1° inclination.

Following completion of the holes, the collars were resurveyed with theodolite and cement markers emplaced. Downhole surveys were completed in all holes with length greater than 100 m, using Sperry-Sun or Maxibor equipment.

The average core recovery was greater than 90%. Core samples were collected during these phases and sent to laboratories for gold assays (discussed in the next section).

Jaguar has continued to carry out drilling and channel sampling programs on the orebodies. The drilling has been carried out from surface locations which provide general information as to the location of the mineralized zones. Further detailed drill hole information is gathered for the three orebodies from underground locations. Final detailed information of the location and distribution of the gold mineralization is collected by means of channel sampling of underground exposures.

Jaguar completed a program of delineation diamond drilling in 2018 from underground stations where 138 holes with a total length of approximately 20,431 m were completed. The drill holes mostly tested the down-plunge continuation of Orebodies A and C. Significant intersections from the delineation drilling programs have been disclosed in news releases issued by Jaguar on February 26, 2018 and June 18, 2018. A selection of the significant intersections encountered during the 2018 drilling campaign using the uncapped gold assay values is provided in Table 10-1 (Jaguar 2018).

TABLE 10-1 SAMPLE SIGNIFICANT INTERSECTIONS FROM THE 2018 DRILLING PROGRAM
Jaguar Mining Inc. –Turmalina Mine Complex

Hole ID	From (m)	To (m)	Core Length (m)	Estimated True Width (m)	Grade (g/t Au)
			Orebody A:		
FTS1580	103.2	120.49	17.29	17.22	10.94
FTS1581	72.24	77.46	5.22	5.20	2.71
FTS1582	61.26	63.59	2.33	2.31	4.02
FTS1583	51.55	55.84	4.29	4.83	5.54
FTS1584	37.67	39.53	1.86	1.84	2.76
And	55.13	60.55	5.42	5.35	17.23
FTS1585	67.01	68.32	1.31	1.30	2.14
FTS1586	81.95	85.97	4.02	3.94	8.90
FTS1593	56.75	60.97	4.22	3.03	3.12
FTS1594	44.66	48.06	3.40	3.03	2.53
FTS1595	41.68	43.74	2.06	2.00	5.14
FTS1596	43.05	47.10	4.05	3.9	7.30
			Orebody C (Growth Drilling):		
FTS1480	172.90	177.00	4.10	3.62	5.50
FTS1481	178.20	184.30	6.10	5.61	2.37
FTS1482	174.30	180.15	5.85	5.11	9.22

Hole ID	From (m)	To (m)	Core Length (m)	Estimated True Width (m)	Grade (g/t Au)
FTS1483	193.05	194.05	1.00	0.80	4.47
FTS1484	182.15	185.25	3.10	2.37	1.47
FTS1485	206.45	209.30	2.85	2.49	3.97
FTS1486	185.00	200.10	15.10	14.65	4.91
FTS1487	217.85	219.95	2.10	1.95	6.62
FTS1488	181.40	188.03	6.63	6.46	1.96
and	192.30	199.30	7.00	6.82	5.51
FTS1550	201.65	202.90	1.25	0.90	1.10
FTS1551	149.05	150.00	0.95	0.89	1.01
FTS1556	206.70	209.40	2.70	2.45	5.11
FTS1557	187.75	192.25	4.50	4.25	7.77
Orebody C (In-fill Drilling):					
FTS1499	26.27	28.29	2.02	1.71	3.49
FTS1501	38.17	40.95	2.78	1.17	2.61
FTS1502	60.22	62.39	2.17	2.07	2.10
FTS1509	28.77	29.52	0.75	0.55	3.27
FTS1515	123.52	127.68	4.16	3.52	12.61
FTS1516	126.15	128.36	2.21	1.93	7.04
FTS1517	64.67	70.35	5.68	4.22	5.42
and	73.48	74.48	1.00	0.74	2.96
FTS1518	50.13	51.13	1.00	0.80	4.63
and	66.56	80.83	14.27	14.27	3.36
Including	70.11	75.43	5.32	5.32	6.17
FTS1519	72.08	85.70	13.62	11.55	3.47
FTS1532	161.02	162.92	1.90	1.74	1.50
FTS1534	59.70	60.91	1.21	1.08	6.52
FTS1536	42.41	47.54	5.13	4.20	4.24
FTS1538	47.91	48.91	1.00	0.79	3.01
FTS1539	63.87	64.97	1.10	0.93	6.09
and	92.24	95.29	3.05	2.58	6.00
FTS1540	68.15	69.15	1.00	0.85	1.45
and	75.55	76.75	1.20	1.02	1.63
and	79.19	80.39	1.20	1.02	2.27
FTS1542	53.07	57.20	4.13	3.85	1.73
FTS1543	55.75	59.10	3.35	3.16	4.61
FTS1547	62.45	68.35	5.90	3.46	4.66
and	92.01	100.79	8.78	6.52	4.04
FTS1548	75.13	80.02	4.89	4.10	5.20
FTS1549	79.77	86.57	8.74	7.32	3.31
FTS1571	110.07	115.94	5.87	4.29	4.05

An additional 157 definition drill holes for a total length of 2,769 m were completed where the holes were targeted to provide detailed information in support of final stope planning and production.

A summary of the drilling and channel sample information that was gathered during 2018 is provided in Table 10-2. The locations of the drill holes completed in 2018 are shown in Figure 10-1. Additional detailed information is provided in Section 14 of this report.

TABLE 10-2 SUMMARY OF DRILL HOLE AND CHANNEL SAMPLES COMPLETED IN 2018
Jaguar Mining Inc. –Turmalina Mine Complex

Category	Number	Total Length (m)
Drill Holes – Definition	138	20,431
Drill Holes – Delineation	157	2,769
Collars, Channel Samples	881	4,665

The surface-based diamond drilling program was carried out by the drilling contractor Mata Nativa using HQ and NQ tools. HQ-sized equipment is used for the portion of the hole that traverses the saprolite horizon and the hole diameter is then reduced to NQ when the fresh rock is reached. The diamond drill core procedures adopted by Jaguar are described below:

- Only drill holes with more than 90% core recovery from the mineralized zone were accepted.
- Drill hole deviations (surveys) were measured by Sperry-Sun or DDI/Maxibor equipment.
- The cores were stored in wooden boxes of one metre length with three metres of core per box (HQ diameter) or four metres of core per box (NQ diameter). The hole's number, depth, and location were identified in the boxes by an aluminum plate on the front of the box and by a water-resistant ink mark on its side. The progress interval and core recovery are identified inside the boxes by small wooden or aluminum plates.

The underground-based drill holes for the 2017 and 2018 drilling programs were completed by Jaguar's personnel and equipment. The drilling was carried out using NQ and BQ sized tools and followed Jaguar's established drilling procedures.

It is clear that the drill holes that have targeted the down-plunge projection of Orebody A have been successful in demonstrating that the gold grades persist to a depth of approximately 300 m below the bottom of the ramp location as at December 31, 2018. The down-plunge limits of the gold grades have not been defined by the drilling completed to date. In RPA's opinion, additional drilling to outline the down-plunge continuation of Orebody A is warranted.

Similarly, the down-plunge limits of the gold grades in portions of Orebody C have not been defined by the drilling completed to date. In RPA's opinion, it is clear that down-plunge continuation of the mineralized shoots within Orebody C warrants a program of exploration drilling.

RPA has not identified any drilling, sampling, or core recovery issues that could materially affect the accuracy or reliability of the core samples.

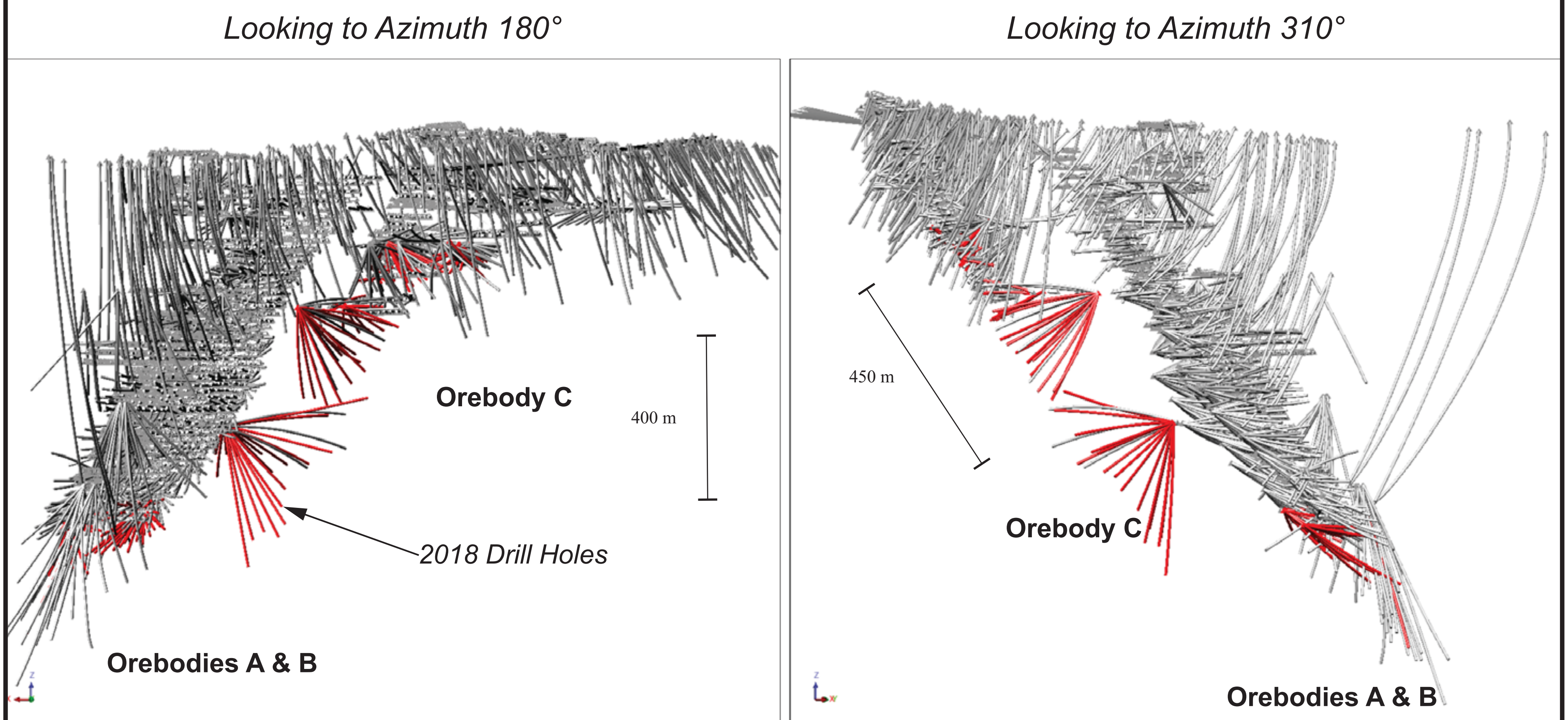


Figure 10-1

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Longitudinal View of the 2018 Drill Hole Locations

April 2019

Source: RPA, 2019.

11 SAMPLE PREPARATION, ANALYSES AND SECURITY

SAMPLING

The sample collection and preparation procedures used by Jaguar are as follows.

SURFACE/EXPLORATION CHANNEL SAMPLING

- Channel samples are regularly collected from outcrops and trenches.
- The sites to be sampled are cleaned with a hoe, exposing the material by scraping it.
- Structures are mapped and the lithologic contacts defined, and samples marked so that no sample has more than one lithology.
- Samples have a maximum length of one metre and are from one kilogram to two kilograms in weight.
- Each sample is collected manually in channels with average widths between five and ten centimetres, and about three centimetres deep, using a hammer and a chisel.
- Either an aluminum tray or a thick plastic canvas drop sheet is used to collect the material.
- The samples are then stored in a thick plastic bag and identified by a numbered label, which is protected by a thin plastic cover and placed with the sample.
- At the sampling site, samples are identified by small aluminum plates, labels, or small wooden poles.
- Sketches are drawn with lithological and structural information. The sample locations are surveyed.

DIAMOND DRILLING CORE SAMPLING

- Surface drilling is performed by contractors with holes in HQ or NQ diameters.
- Underground drilling in 2018 was performed either by Jaguar or contractors with core diameters of either HQ, NQ, BQ, or LTK diameters.
- Drill holes are accepted only if they have more than 85% of recovery from the mineralized zone.
- All the drill holes have their deviations measured by Maxibor or equivalent survey tool.

- The cores are stored in wooden boxes of one metre length with three metres of core per box (HQ diameter) or four metres of core per box (BQ or LTK diameters).
- The number, depth, and location of each hole are identified in the boxes by an aluminum plate or by a water-resistant ink mark in front of the box.
- The progress interval and core recovery are identified inside the boxes by small wooden plates.
- During logging, all of the geological information, progress, and recovery measures are verified and the significant intervals are defined for sampling.
- Samples are identified in the boxes by highlighting their side or by labels.
- Core samples are cut lengthwise using a diamond saw into approximately equal halves. On occasion, the core samples are split by means of manual or hydraulic core splitting equipment.
- One half of the sample is placed in a highly resistant plastic bag, identified by a label, and the other half is kept in the box at a warehouse.
- The remaining drill core from the surface-based drill holes is stored at an offsite secure location close to the mine.
- For the shorter-length, bazooka-type drill holes completed from underground set-ups (the LM-series drill holes), the whole core is sampled as the core diameter does not permit splitting into halves.

UNDERGROUND PRODUCTION CHANNEL SAMPLING

- The sector of wall to be sampled is cleaned with pressurized water. Structures are mapped and lithologic contacts defined, and samples marked so that no sample has more than one lithology. Samples have a maximum length of one metre and are from two to three kilograms in weight.
- Channel samples were taken by manually opening the channels, using a hammer and a little steel pointer crowned by carbide or a small jackhammer.
- The channel samples have lengths ranging from 50 cm to one metre, average widths between five and ten centimetres, and about three centimetres deep.
- Two sets of channel samples on the face are regularly collected. One set of channel samples are taken from the top of the muck pile once the work area has been secured. The second set of channel samples are taken at waist height once the heading has been mucked clean and secured.
- At approximately 5 m intervals, the walls and back are sampled by channel sampling. The channel samples are collected starting at the floor level on one side and continue over the drift back to the floor on the opposite side.

- Either an aluminum tray or a thick plastic canvas is used to collect the sample material. The samples are then stored in a thick plastic bag and identified by a numbered label, which is protected by a thin plastic cover and placed with the sample.
- At the sampling site, samples are identified by small aluminum plates, labels, or small wooden poles.
- Sketches are drawn with lithological and structural information. The sample locations are then surveyed and are entered into the master database.

SAMPLE PREPARATION AND ANALYSIS

For drill holes and channels collected by Jaguar, samples are prepared at Jaguar's mine site laboratories by drying, crushing to 90% minus 2 mm, quartering with a Jones splitter to produce a 250 g sample, and pulverizing to 95% minus 150 mesh. Analysis for gold is by standard fire assay procedures, using a 50 g or 30 g sample and an atomic absorption (AA) finish.

A process control laboratory at the Turmalina Mine analyzes the shift and plant samples, while all delineation drill core, channel, and exploration drill core samples from the Turmalina deposit are forwarded to the in-house laboratory located at the Caeté mine site.

At Jaguar's Caeté laboratory, the samples are dried and then crushed. A one kilogram sub-sample of the crushed material is selected for pulverization to approximately 70% minus 200 mesh. The ring-and-puck pulverizers are cleaned after each sample using compressed air and a polyester bristle brush. The analytical protocol for all samples employs a standard fire assay fusion using a standard 30 g aliquot, with the final gold content being determined by means of AA. The detection limit for fire assay analyses is 0.05 g/t Au. A second cut from the pulps is taken and re-assayed for those drill core samples where the grade is found to be greater than 30 g/t Au. If the two assays are in good agreement, only the first assay is reported. The AA unit is calibrated to directly read gold grades up to 3.3 g/t Au – samples with grades greater than this are re-assayed by diluting the solute until it falls within the direct-read range.

RPA has reviewed the field and underground sampling procedures and is of the opinion that they meet accepted industry standards. In RPA's opinion, the sample preparation, analysis, and security procedures at the Turmalina Mine Complex are adequate for use in the estimation of Mineral Resources.

QUALITY ASSURANCE AND QUALITY CONTROL

The geological team at the Turmalina Mine Complex carried out a Quality Assurance and Quality Control (QA/QC) program that monitored the analytical results of samples from the 2018 diamond drilling program. This program is separate and distinct from the QA/QC program that is carried out by the Caeté laboratory. In all 390 blank samples and 284 samples of Certified Reference Materials (CRM) were inserted into the sample stream in 2018. The results were presented in graphical form to RPA and were found to be of an acceptable quality.

No duplicate samples were sent by the Jaguar geological team to either the in-house Caeté laboratory nor to external laboratories. RPA recommends that Jaguar send a approximately 5% of pulps from the 2018 drilling program to an external laboratory for duplicate analysis.

Commercially sourced CRMs obtained from Rocklabs are inserted by the Turmalina geological team into their sample stream at a frequency of every 45 to 50 samples. A list of the CRMs that were used is provided in Table 11-1.

TABLE 11-1 LIST OF CERTIFIED STANDARD REFERENCE MATERIALS, 2018 QA/QC PROGRAM
Jaguar Mining Inc. –Turmalina Mine Complex

Standard No.	Recommended Value	Standard Deviation	Number Analyzed
HiSilK4	3.463	0.09	65
SH82	1.333	0.027	22
Si81	1.79	0.03	50
SK93	4.079	0.089	63
SK94	3.899	0.084	24
SL76	5.96	0.192	28
SN91	8.679	0.194	13
SP73	18.17	0.42	19

Blank samples are inserted at a rate of one in every 20 samples, representing an insertion frequency of 5%. Blank samples are composed of crushed, barren quartzite or gneiss and are used to check for contamination and carry-over during the crushing and pulverization stage.

The results of the blanks, duplicates, and standards are forwarded to Jaguar's head office on a monthly basis for insertion into the Jaguar's internal database (referred to as the BDI database). There, the results from the standards samples are scanned visually for out-of-range values on a regular basis. When failures are detected, a request for re-analysis is sent to the laboratory – only those assays that have passed the validation tests are inserted into the main database.

Sample control charts are presented in Figures 11-1 to 11-3.

The Caeté laboratory carries out an internal program of QA/QC for all drill core samples and channel samples. The QA/QC protocol includes carrying out a blank and duplicate analysis after every 20 samples, representing an insertion frequency of 5%. In total, the Caeté laboratory analyzed 2,369 blank samples for both the Turmalina and Pilar mines combined for the January to December 2018 period. A total of 613 duplicate pulp samples were analyzed by the Caeté laboratory from the 2018 drilling program at the Turmalina deposit. The results are graphically presented in Figure 11-4. No duplicate samples were sent by the Caeté laboratory to external laboratories for the 2018 drilling campaign at the Turmalina deposit.

FIGURE 11-1 CONTROL CHART FOR BLANK SAMPLES, CAETE LABORATORY, JANUARY TO DECEMBER 2018

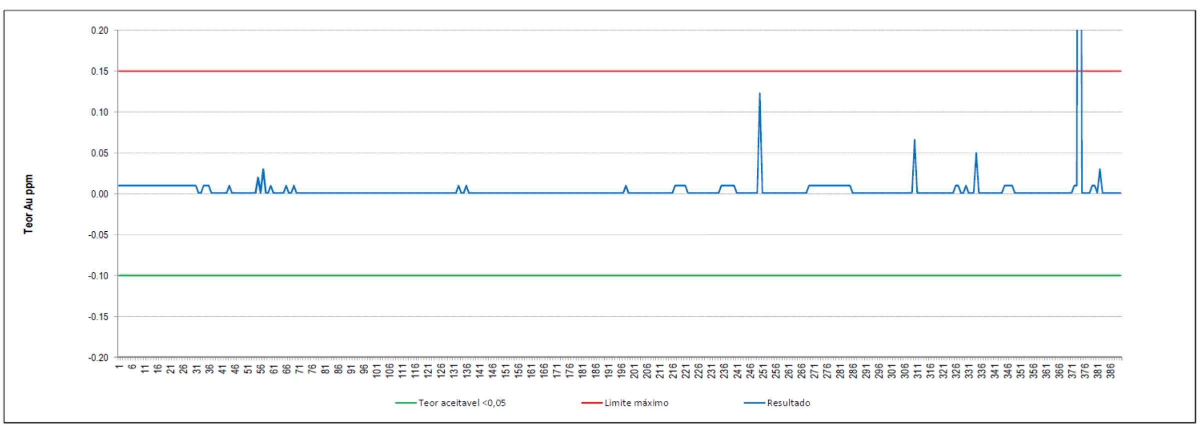


FIGURE 11-2 CONTROL CHART FOR CERTIFIED REFERENCE MATERIAL HISILK4, JANUARY TO DECEMBER 2018

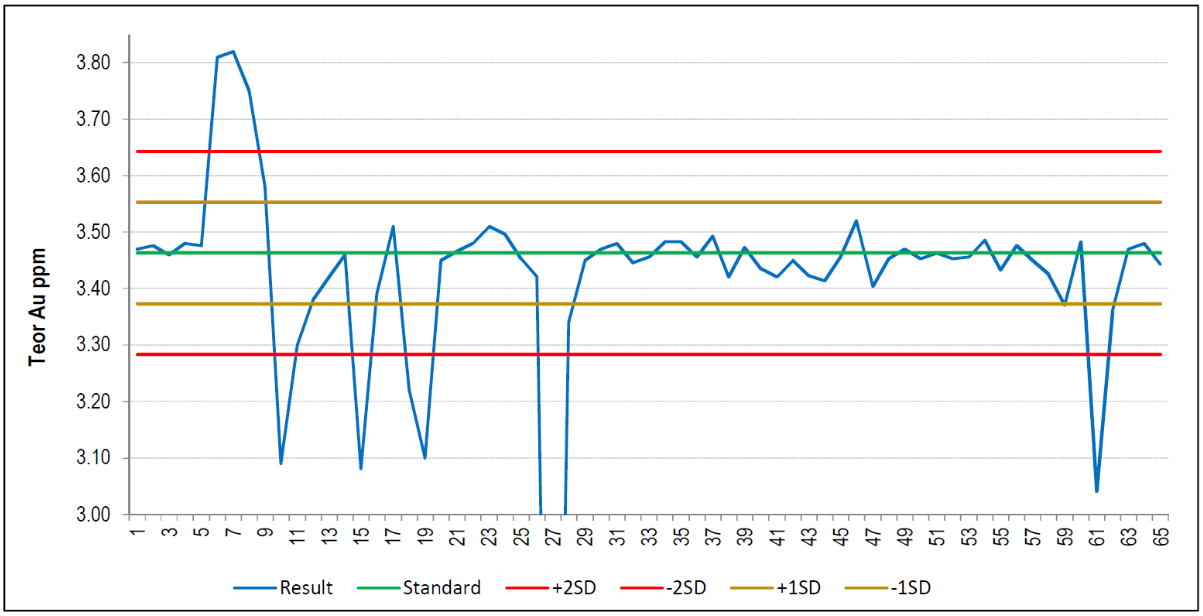


FIGURE 11-3 CONTROL CHART FOR CERTIFIED REFERENCE MATERIAL RL SK93, JANUARY TO DECEMBER 2018

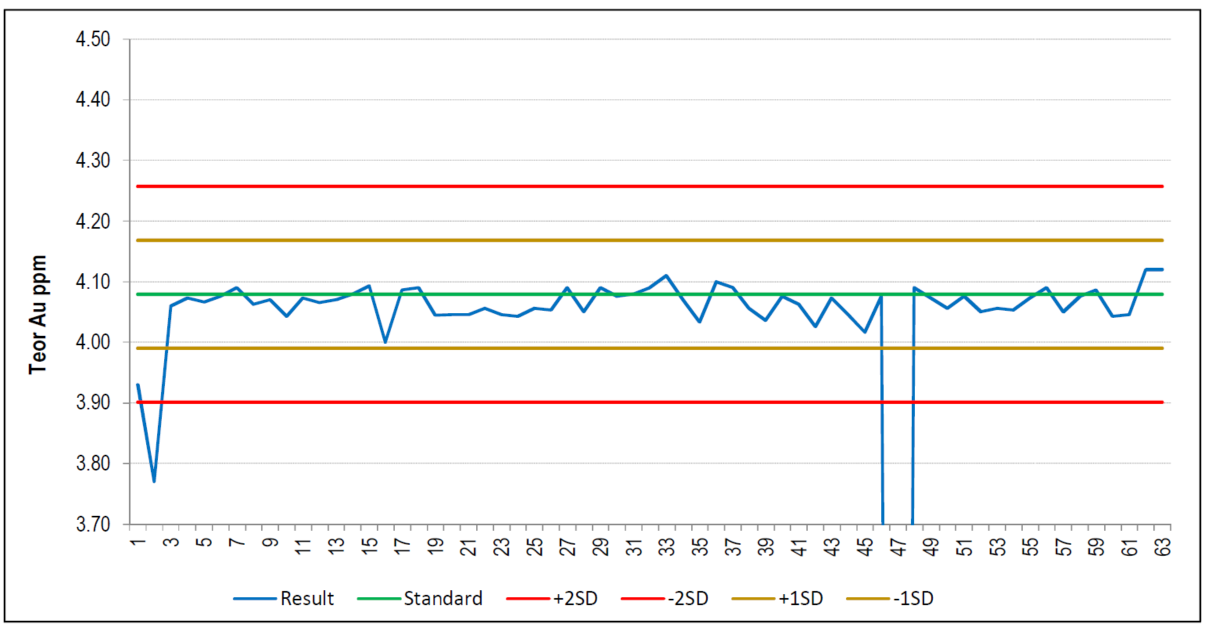
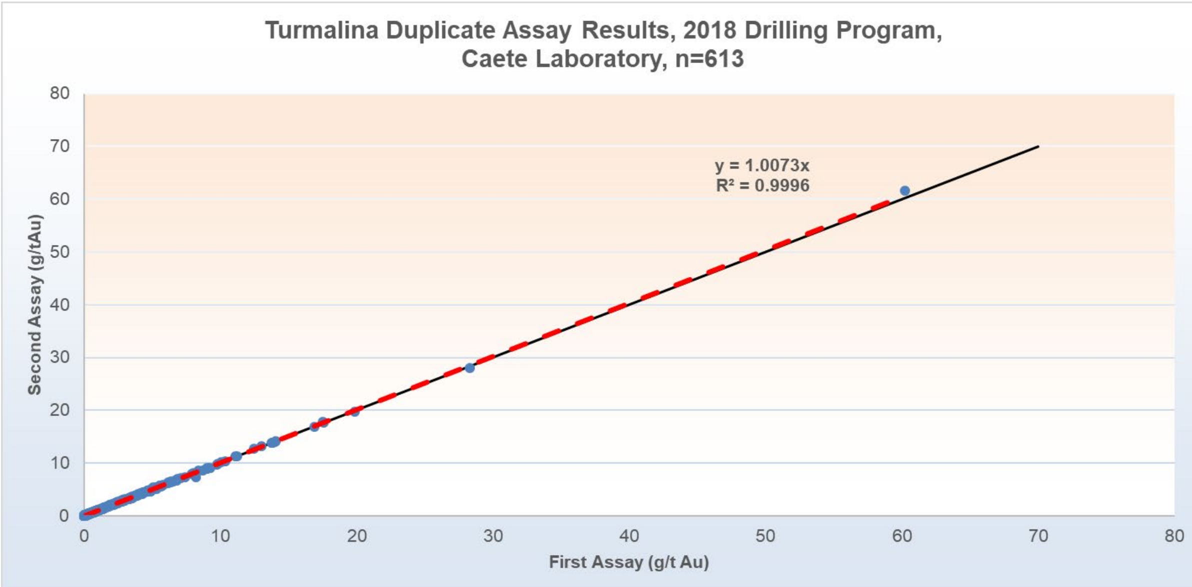


FIGURE 11-4 CONTROL CHART FOR DUPLICATE SAMPLES, CAETE LABORATORY, JANUARY TO DECEMBER 2018



In RPA's opinion, the QA/QC program as designed and implemented by Jaguar is adequate and the assay results within the database are suitable for use in a Mineral Resource estimate.

12 DATA VERIFICATION

RPA's validation checks on the Turmalina deposit drilling and sampling database provided by Jaguar in support of the 2018 Mineral Resource estimate included:

- Conducted a site visit in 2014 and 2017 to personally inspect the style and structural complexity of the gold mineralization and its host rocks.
- Carried out independent validation of the 2015 and 2016 drill hole databases as described in RPA (2016 and 2017).
- Carried out independent validation of the drill hole database by means of spot checking of 13 drill holes completed in 2018 (approximately 10% of the newly completed drill holes) which intersected significant gold mineralization in both Orebodies A and C.
- Checked collar locations relative to either the digital topographic surface or the location of the underground excavation digital model as appropriate.
- Reviewed drill hole and sample orientations (azimuth/dip) relative to the location of the mineralized zones.
- Completed validity checks for out-of-range values, overlapping intervals, and mismatched sample intervals.
- Reviewed the reasonableness of the geological interpretations relative to the nature of the previously extracted mineralization and the newly discovered mineralized intervals.
- Reviewed the geological wireframes to ensure that a minimum mining width was honoured.
- Reviewed the coding of the mined out material in the block model to ensure a reasonable match with the excavation model.

No significant errors were noted for the collar, survey, lithology, or assay records reviewed. RPA did observe some minor discrepancies on the order of one metre between the location of the collars of some underground-based drill holes and the excavation models. These discrepancies are likely due to survey errors in the determination of either the drill hole collars or the excavation models and may contribute to errors in the mine design and excavation phases of the mining operation. RPA recommends that Jaguar carry out a review of its surveying practices and quality control procedures to ensure that all drill hole collars are accurately located prior to entry into the final drill hole database.

The surface and underground drill hole collar locations are reasonable and channel samples are appropriately located with respect to the existing underground infrastructure.

RPA is of the opinion that the drilling and sampling database is appropriate to be used in the preparation of Mineral Resource and Mineral Reserve estimates.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

TURMALINA MINE METALLURGICAL TESTS

Machado (2005) reports that AngloGold carried out the following metallurgical testwork:

- Metallurgical testwork in 1987 on 65 kg of mineralized core, 90% minus 200 mesh. Recovery by direct cyanidation (apparently bottle roll tests) yielded 91.4%.
- Metallurgical testwork in 1992 on mineralized material from the 640 m level, 50 m below the pit floor. Recovery by direct cyanidation (apparently bottle roll tests) yielded 90.3%.
- Metallurgical testwork in 1993 on a 44.9 t sample grading 5.84 g/t Au, from the 640 m and 626 m levels. Samples crushed to 90% and 100% minus 400 mesh yielded recoveries of 86% and 93%, respectively, using direct cyanidation (apparently tank tests).
- Metallurgical testwork in 1994 on a 17,000 t bulk sample grading 5.24 g/t Au. The bulk sample was treated at AngloGold's Nova Lima Pilot Plant, near Belo Horizonte.

A summary of the historical testwork that was carried out prior to Jaguar's ownership is provided in Table 13-1.

In January 2005, as part of the feasibility study work, a 10 t bulk sample was mined from underground for testing purposes (Clow and Valliant, 2006). From this sample, six tonnes were used for the testing as described below:

1. METSO Laboratories, Brazil:
    a. Full crushing tests to determine the size distribution and equipment design parameters.
2. CETEC, Brazil:
    a. Conventional bottle roll tests at various grinds.
3. Dawson Laboratories Inc., USA:
    a. Bond Ball Mill Work Index Tests
    b. Adsorption Kinetic Tests
4. Dawson Laboratories and CDTN Research Center, Brazil:
    a. Agitated leach cyanidation tests at various grinds. Both laboratories reported leaching recoveries of 92% for the 200 mesh samples and 94% for 400 mesh.
5. Federal University of Minas Gerais, School of Engineering – Mining Engineering Department Laboratory, Brazil

a. Settling Tests
b. Dynamic Viscosity Tests

6. Lakefield and Geosol, Brazil:
    a. Tailings characterization tests to determine acid generation potential.

7. Mine System Design Inc. (MSD), USA:
    a. Paste fill tests

8. AngloGold Laboratory, Brazil:
    a. Leaching testwork. The samples consisted of diamond drill core from the Principal and NE Zones and attained metallurgical recoveries of 92.96% and 92.87%, respectively.

Jaguar's testwork of 2005 and 2006 is summarized in Table 13-1.

TABLE 13-1 HISTORICAL METALLURGICAL TESTWORK
Jaguar Mining Inc. – Turmalina Mine Complex

Year	Owner	Laboratory	Testwork	Results
1987	AngloGold	Morro Velho Mine	Gravity-Flotation-Cyanidation testing on 65 kg sample	Gravity recovery=10.4%
			grading 6.23 g/t Au	Flotation-Cyanidation recovery=90%x90%=81%
				Total recovery=91.4%
1992	AngloGold		Bottle roll	90.3% recovery @ 90% minus 200 mesh
1993-94	AngloGold		35 t bench scale cyanidation	86% recovery @ 90% minus 200 mesh
				93% recovery @ 90% minus 400 mesh
2005	Jaguar	METSO	Optimize crushing/screening by testing 6 t sample	
			Crush to 100 minus 3/8"	
			Test crushability & rod mill indices	
			Measure particle & bulk densities	
			Test abrasiveness	
			Measure flatness index	
2005	Jaguar	CETEC	Bottle roll on 90% minus 100, 200, & 325 mesh	
2005	Jaguar	Dawson Laboratories Inc.	Bond ball mill work index tests @ 100, 200, & 400 mesh	
			Adsorption kinetic tests to study carbon in pulp (CIP) vs. carbon in leach (CIL)	

Year	Owner	Laboratory	Testwork	Results
2005	Jaguar	CDTN Research Centre	Cyanidation in agitated tanks on 90% minus 200 & 325 mesh	92% recovery @ 90% minus 200 mesh 94.5% recovery @ 90% minus 325 mesh
2005	Jaguar	Federal Univ. of Minas Gerais	Viscosity, settling, and flocculent tests for thickener design	
2005	Jaguar	Lakefield/Geosol	Tailings characterization to study acid generation potential	
2005-06	Jaguar	Mine System Design (MSD)	Paste fill preparation tests	
2006	Jaguar	AngloGold Laboratory	Leaching tests	92.96% recovery, Principal Zone, 92.87% recovery NE Zone

FAINA, PONTAL, AND OREBODY D TESTING PROGRAMS

OXIDE MINERALIZATION

In August 2009, direct cyanidation testing was performed by Jaguar's in-house process laboratory, located in Caeté, on oxide mineralization from the Faina deposit. This cyanidation testing resulted in an average gold extraction of 96.1% on a sample of approximately 83% minus 200 mesh.

In August 2011, direct cyanidation testing was performed by Jaguar's in-house process laboratory on oxide mineralization from the Orebody D target. The results indicate the Orebody D target oxide mineralization is amenable to cyanidation.

In February 2010, direct cyanidation testing was performed by Jaguar's in-house process laboratory on oxide mineralization from the Pontal deposit. The cyanidation testing resulted in an average gold extraction of 94.1%.

SULPHIDE MINERALIZATION

In May 2008, direct cyanidation testing was performed by Jaguar's in-house process laboratory on a sample of sulphide mineralization from the Faina deposit. The testing resulted in an average gold extraction of 42.91% at 80% minus 200 mesh and an average gold extraction of 42.99% at 80% minus 270 mesh, indicating that a portion of the Faina deposit sulphide mineralization is refractory. In November 2008, direct cyanidation testing was performed by Jaguar's in-house process laboratory on sulphide mineralization from Orebody D. The cyanidation testing resulted in an average gold extraction of 60.0% at 90% minus 200 mesh, indicating that a portion of Orebody D sulphide mineralization is refractory (Machado, 2011).

In October 2010, Jaguar engaged Resource Development Inc. (RDi) to complete a metallurgical test program on a 150 kg composite sample from the Faina and Orebody D deposits. The objective of this test program was to identify and develop the best treatment processing route for the extraction of gold from the refractory sulphide deposits. This metallurgical test program included grinding testwork, gravity concentration, whole ore cyanidation, carbon-in-leach (CIL), and flotation and pressure oxidation of whole ore, flotation concentrate. The RDi test program indicated that 45% of the gold in the composite sample was free milling and the remaining gold was refractory. RDi concluded the best treatment route for the composite sample tested was to float the sulphides, pressure oxidize the flotation concentrate, and treat the oxidized material and flotation tailings in a CIL circuit to recover gold. In this manner, the overall gold extraction for the refractory gold mineralization from the Faina and Orebody D deposits combined mineralized material is projected to be approximately 87.4% (Machado, 2011).

In September 2011, RDi completed a metallurgical test program on an approximately 50 kg sample of refractory sulphide mineralization from the Pontal deposit. The objective of the testing was to determine if the metallurgical recovery of the refractory sulphide mineralization can be improved by roasting and subsequent cyanidation over direct cyanidation. Direct cyanidation resulted in a gold extraction of 58.0% and cyanidation of roasted mineralization improved the gold extraction to 80.3% (Machado, 2011).

14 MINERAL RESOURCE ESTIMATE

SUMMARY

Table 14-1 summarizes the Mineral Resources as of December 31, 2018 based on a US$1,500/oz gold price for the Turmalina deposit and a gold price of US$1,400/oz for the Faina and Pontal deposits. A cut-off grade of 2.10 g/t Au was used to report the Mineral Resources for the Turmalina deposit, and cut-off grades of 3.8 g/t Au and 2.9 g/t Au were used to report the Mineral Resources for the Faina and Pontal deposits, respectively. The Mineral Resource estimates for the Faina and Pontal deposits were prepared with an effective date of December 31, 2014 and were disclosed in RPA (2015).

The updated block model for the Turmalina deposit is based on drilling and channel sample data using a data cut-off date of December 31, 2018. The database comprises 3,934 drill holes and 16,246 channel samples. The estimate was generated from a block model constrained by three-dimensional (3D) wireframe models that were constructed using a minimum width of two metres. The gold grades are interpolated using the inverse distance cube (ID^3) interpolation and the ordinary kriging algorithms using capped composited assays. A capping value of 50 g/t Au was applied for all three orebodies. The wireframe models of the mineralization and excavated material for the Turmalina, Faina, and Pontal deposits were constructed by Jaguar in close consultation with RPA.

The mineralized material for each orebody was initially classified into the Measured, Indicated, or Inferred Mineral Resource categories on the basis of the search ellipse ranges as obtained from the variography studies and the estimation passes. These preliminary classifications were subsequently modified by digital and manual methods that considered the observed continuity of the mineralization, the drill hole and channel sample density, and previous production experience with these orebodies to achieve a smoothed classification result.

TABLE 14-1 SUMMARY OF TOTAL MINERAL RESOURCES – DECEMBER 31, 2018
Jaguar Mining Inc. – Turmalina Mine Complex

Category	Tonnes (000)	Grade (g/t Au)	Contained Oz Au (000)
Turmalina			
Measured	1,767	5.37	305
Indicated	1,486	5.70	272
Sub-total M&I	**3,253**	**5.52**	**577**
Inferred	1,066	4.31	148
Faina			
Measured	72	7.39	17
Indicated	189	6.66	42
Sub-total M&I	**261**	**6.87**	**58**
Inferred	1,542	7.26	360
Pontal			
Measured	251	5.00	40
Indicated	159	4.28	22
Sub-total M&I	**410**	**4.72**	**62**
Inferred	130	5.03	21
Total Turmalina, Faina, and Pontal deposits			
Measured	2,090	5.40	362
Indicated	1,834	5.68	336
Total M&I	**3,924**	**5.53**	**697**
Inferred	2,738	6.00	529

Notes:
1. CIM (2014) definitions were followed for Mineral Resources.
2. Mineral Resources include the Turmalina deposit, Faina deposit, and Pontal deposit.
3. Mineral Resources are inclusive of the Mineral Reserves at the Turmalina deposit.
4. Mineral Resources are estimated at a cut-off grade of 2.1 g/t Au at Turmalina, 3.8 g/t Au at Faina, and 2.9 g/t Au at Pontal.
5. Mineral Resources at the Turmalina deposit include all drill hole and channel sample data and mining excavations as of December 31, 2018. Mineral Resources at the Faina and Pontal deposits include drill hole information as of December 31, 2014.
6. Mineral Resources are estimated using a long-term gold price of US$1,500 per ounce for the Turmalina deposit and US$1,400 per ounce for the Faina and Pontal deposits.
7. Mineral Resources are estimated using an average long-term exchange rate of 3.70 Brazilian Reais: 1 US Dollar for the Turmalina deposit and 2.50 Brazilian Reais: 1 US Dollar for the Faina and Pontal deposits.
8. A minimum mining width of two metres was used.
9. Bulk density is 2.83 t/m^3 for Orebodies A and B and 2.91 t/m^3 for Orebody C at the Turmalina deposit.
10. Gold grades are estimated by the ordinary kriging interpolation algorithm using capped composite samples.
11. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
12. Numbers may not add due to rounding.

TURMALINA DEPOSIT

DESCRIPTION OF THE DATABASE

Current drilling and sampling practices involve the initial delineation of the location of the mineralized lenses using either surface-based or underground-based drill holes as appropriate. For the 2018 drilling program, all drilling was completed from underground stations. Once sufficient primary underground access has been established, the mineralized lenses are further outlined by underground-based drill holes at a nominal spacing of 25 m to 50 m. As development of the underground access progresses on the ore, a series of channel samples are taken in two locales (one set on the face and one set along the back) for each round. The average channel sample spacing along development drifts is five metres.

Jaguar maintains an internal database (referred to as BDI), which is used to store and manage all of the digital information for all of its operations. The drill hole database contains drill hole and channel sample information that is coded according to the following naming conventions (Table 14-2).

TABLE 14-2 DRILL HOLE DATABASE, TURMALINA DEPOSIT
Jaguar Mining Inc. – Turmalina Mine Complex

Hole Series	Description
FSN	Jaguar Drill Holes, Orebody C
FMT	Jaguar Drill Holes, Orebodies A and B
FTS	Jaguar Drill Holes
LM	Jaguar Drill Holes
FC	Jaguar Drill Holes
JM*	Jumbo Drill Holes
SMB*	Blast Holes (open pits)

*Note: JM-series and SMB-series drill hole and assay information are not used for construction of mineralized wireframes or grade estimation purposes.

The drill hole and channel sample information for the Turmalina deposit were extracted from this internal database into separate files for use in preparation of the Mineral Resource estimates. The cut-off date for the drill hole database is December 31, 2018. The drilling and sampling was carried out using the UTM Datum Córrego Alegre, Zone 23S grid coordinate system.

A summary of the drilling and channel sampling information is provided in Table 14-3.

TABLE 14-3 DESCRIPTION OF THE TURMALINA DEPOSIT DATABASE AS AT DECEMBER 31, 2018
Jaguar Mining Inc. – Turmalina Mine Complex

Table Name	Records
assay_minesight_raw	310,776
Collar (3,934 drill holes and 16,246 channel samples)	20,180
comps_minesight	38,796
litho	103,295
survey	147,343
weather	86,689

This drill hole information was modified slightly so as to be compatible with the format requirements of the Hexagon HxGN MinePlan 3D v.15.30 mine planning software and was imported into that software package. A number of new tables were created during the estimation process to capture such information as the intersection information between the drill holes and the wireframe models, density readings, capped assay records, and composited assay records.

The database included a number of assay records which contained entries of negative values to represent intervals of no sampling, lost core, lost sample, or no core recovery, some of which are contained within the mineralized wireframes. Depending upon the specific local conditions, these null values can introduce an undesired positive bias upon the grade estimations. Jaguar therefore elected to pursue a conservative approach by inserting a very low gold value of 0.01 g/t Au for these intervals of null values. While a large portion of these un-sampled intervals are located in older drill holes that have intersected mineralization that has now been excavated, some instances of un-sampled intervals along the expected position of the mineralized zones continue to occur in more recently completed drill holes. RPA recommends that the core logging and sampling procedures be updated so that the logging geologist ensures that a full series of samples are taken through those portions of the drill holes that are expected to intersect the mineralized zones. The samples should cover not only the expected mineralized intervals but extend a short distance into the adjacent wall rocks as well. A proper, complete series of drill core samples are a key item in the preparation of an accurate Mineral Resource estimate.

The Turmalina deposit database also contains a large number of entries for older channel sample and drill hole information which are either clearly in error or for which the confidence of the mineralized intervals are uncertain due to conflicts with more current and accurate information. In these cases, the erroneous and uncertain drill holes and channel samples are flagged and are not used in the preparation of the grade estimation. A summary of the erroneous and suspicious drill holes is presented in Table 14-4.

TABLE 14-4 SUMMARY OF DRILL HOLE AND CHANNEL SAMPLES EXCLUDED FROM ESTIMATION, TURMALINA DEPOSIT
Jaguar Mining Inc. – Turmalina Mine Complex

Sample Type	Number of Channels or Drill Holes
Channel Samples, Orebody A	971
Channel Samples, Orebody B	225
Channel Samples, Orebody C	225
FMT-series Drill Holes	77
FSN-series Drill Holes	57
Drill Holes, Other	301
Total	**1,856**

RPA recommends that all efforts be undertaken to carry out whatever remedial actions are available and appropriate to correct the erroneous or suspicious information for those drill holes that are located in the as-yet un-mined portions of the Turmalina deposit. For those drill holes and channel samples that remain, RPA recommends that they be removed from the active database into a database that is dedicated specifically for these records.

RPA notes that the deposits are well drilled and well sampled. The drilling and sampling protocols permit the identification and delineation of the mineralized areas with confidence. The drilling and sampling practices are carried out to a high standard. RPA is of the opinion that the drill hole and sampling database is suitable for use in preparation of Mineral Resource estimates.

MINERALIZATION WIREFRAMES

The interpreted 3D wireframe models of the gold mineralization have been created using the assay values from surface- and underground-based drill holes, and channel sample data as available. Wireframe models of the gold distribution for the three orebodies were created using the Hexagon HxGN MinePlan and the Leapfrog Geo version 4.3 software packages.

The wireframe limits were drawn using a cut-off grade of 0.50 g/t Au and a nominal minimum width of 2.0 m. Some lower grade gold values were included inside the wireframes to preserve the continuity of the interpretation. The wireframe models were clipped to the original, pre-mining topography surface.

RPA recommends that Jaguar slightly modify the wireframe construction strategy to use a cut-off grade that more closely reflects the Mineral Reserve cut-off grade for each Orebody. By adopting this approach, RPA anticipates that the average grades of the mineralized wireframes will increase due to this more selective approach as a result of reducing the amount of internal dilution that is currently being included into the wireframe models.

The main production of the mine has been from Orebody A, which is dominated by a folded, steeply northeast dipping tabular deposit that is located in a biotite schist host rock. Contouring activities have shown that the gold grades are oriented along a steep southeasterly plunge within this main, folded portion of the deposit. Additional, smaller mineralized zones also contribute to the production from Orebody A. These zones occur mostly as steeply dipping, tabular zones that are oriented either sub-parallel with or at a slight angle with the “fold axis” of Orebody A. In total, Orebody A is comprised of 12 separate mineralized zones. The drilling results from the 2018 program have continued to be successful in intersecting the down-plunge extension of Orebody A. Better gold grades and mineralized widths are found with increased abundances of quartz and pyrite-arsenopyrite in the nose area of this fold-like structure, however good gold grades can also be found as steeply plunging shoots along the fold limbs as well. The mineralization in this deposit has been outlined along a strike length of approximately 250 m to 300 m and to depths of 1,100 m to 1,150 m below surface. The deposit is accessed by a ramp system that has supported production over a vertical distance of approximately 875 m. The mineralization in Orebody A has been defined by drilling below the lowest working level and good potential remains for discovering additional mineralization along the down-plunge projection with additional drilling.

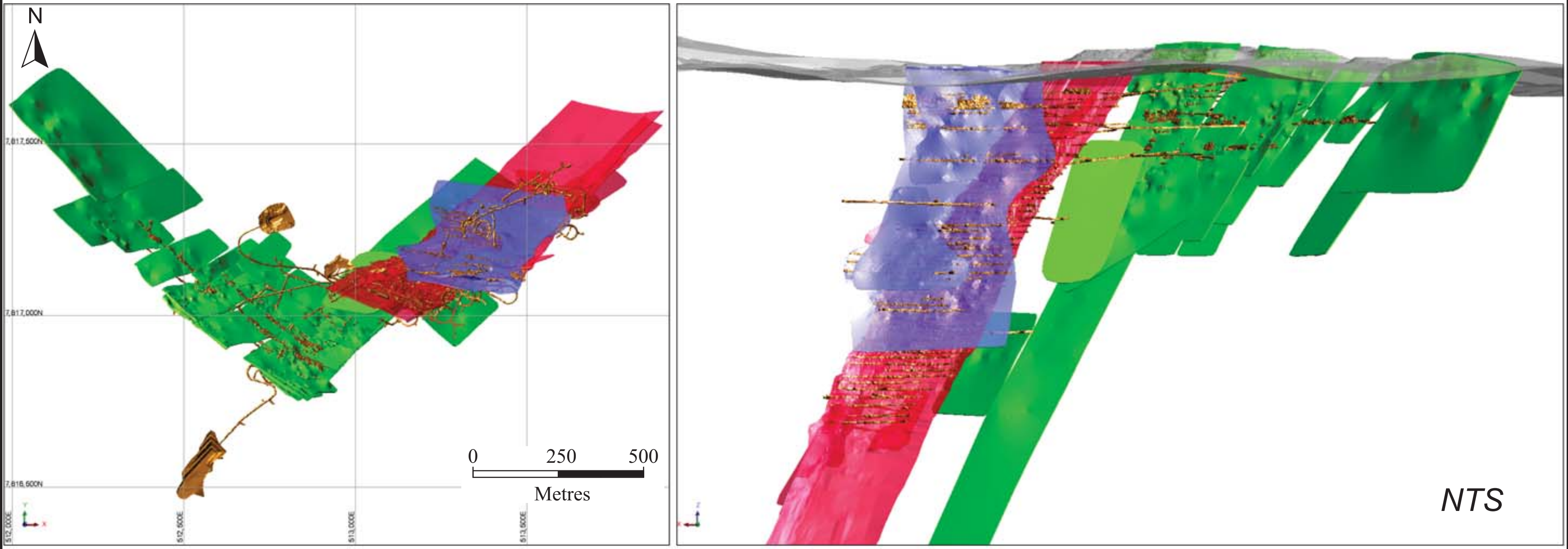
Orebody B includes two lower grade lenses that are oriented approximately parallel to Orebody A. They are located approximately 50 m to 75 m in the structural hanging wall or Orebody A and are accessed in the upper levels of the mine by a series of cross-cuts that are driven from Orebody A development. The mineralization in this deposit has been outlined along a strike length of approximately 350 m to 400 m and to depths of 650 m to 700 m below surface.

As a result of the drilling campaigns carried out in 2018, additional mineralized zones have been discovered such that Orebody C has now increased to include a series of 26 lenses that are located to the west in the structural footwall of Orebody A (Figure 14-1). The mineralization occurs as a number of tabular sheets that strike in a northwesterly direction and dip steeply to the northeast. The lower portions of the Orebody C mineralization are accessed by two cross-cuts from the main ramp, while access to the upper levels is via ramp access from the southwest. While historically a minor amount of production has been achieved from these lenses to date, the increasing successes of Jaguar's drilling programs are leading to production plans where an increasing proportion of the production is being sourced from Orebody C. The mineralization in this deposit has been outlined along a strike length of approximately 1,100 m to 1,200 m and to depths of 800 m to 850 m below surface.

Two of the newly discovered mineralized lenses are located between Orebody A and the previously known lenses comprising Orebody C. These new lenses were discovered as a result of the exploration drilling that was carried out from the underground drill bays to define and evaluate the lower portions of the southeast portion of Orebody C (CSE) mineralized lenses. As these are newly discovered lenses, their full limits and economic potential are not fully understood at present. RPA agrees with the view of Jaguar's geological team that the presence of these mineralized lenses demonstrate that the presence of potentially economic mineralization is not restricted to only the previously defined mineralized horizons. The possibility of additional mineralized zones located elsewhere in the mine stratigraphy must be considered and evaluated as exploration targets.

An example cross sectional view of the mineralized wireframes for Orebody C is presented in Figure 14-2.

Plan View *Isometric View*



Legend:
- *Orebody A*
- *Orebody B*
- *Orebody C*
- *As-Mined Excavations*

Figure 14-1

Jaguar Mining Inc.

Turmalina Mine Complex
Mina Gerais State, Brazil

Overview of the Mineralized Wireframes - Turmalina Deposit

April 2019

Source: RPA, 2019.

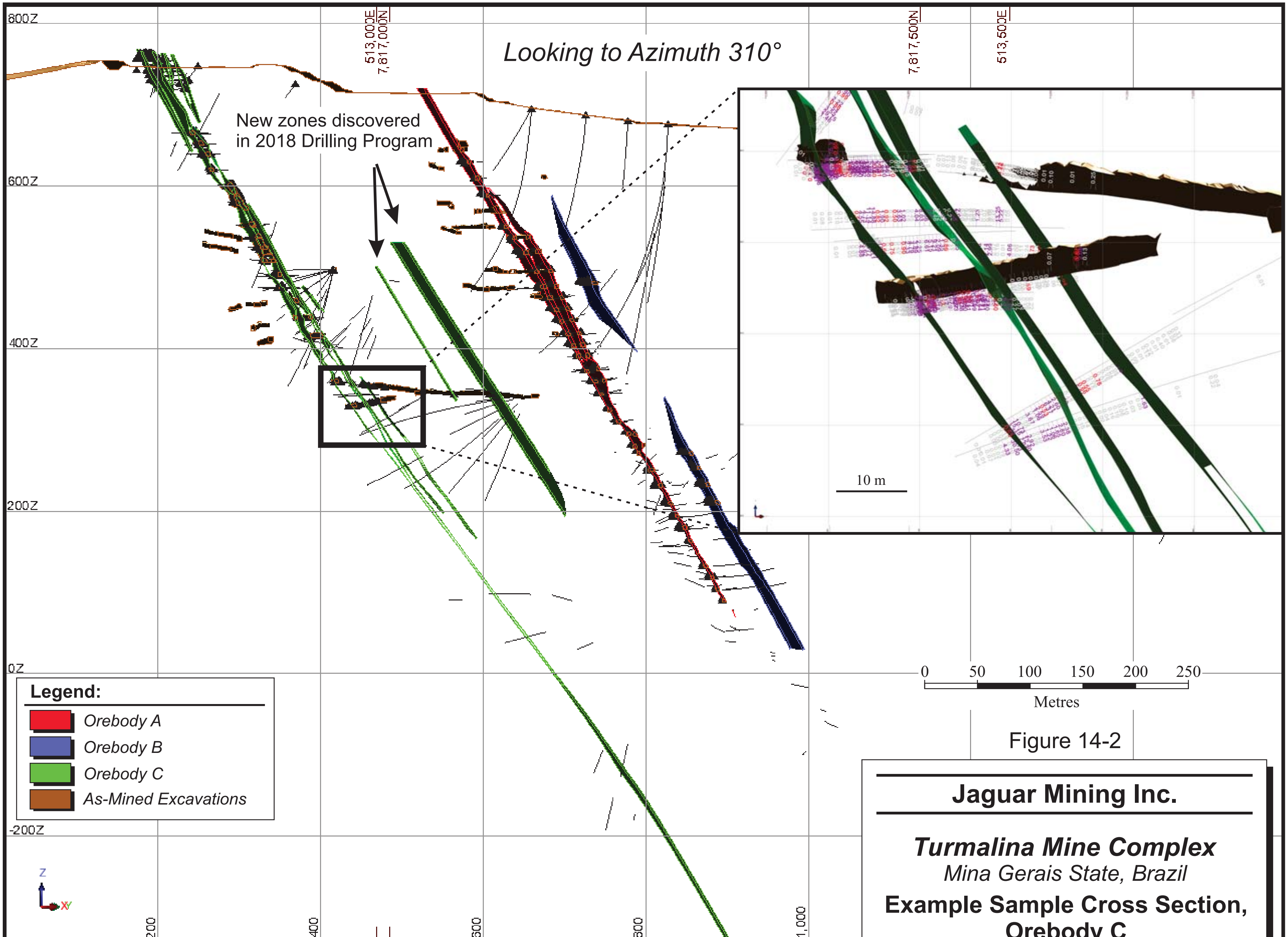


Figure 14-2

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Example Sample Cross Section, Orebody C

April 2019

Source: RPA, 2019.

Review of the wireframes by RPA reveals that the interpretations are reasonable and appropriate. The various mineralized lenses have been grouped into domains for statistics and modelling purposes. Integer codes were assigned to the various zone wireframes and then the wireframes were used to transfer these codes to the block model. The coding provided the means to customize grade interpolation parameters for each zone and to ensure that only the composites from a given mineralized lens were used to estimate the grades for that same lens. A listing of the domain codes is provided in Table 14-5.

TABLE 14-5 LIST OF WIREFRAME DOMAIN CODES, TURMALINA DEPOSIT
Jaguar Mining Inc. – Turmalina Mine Complex

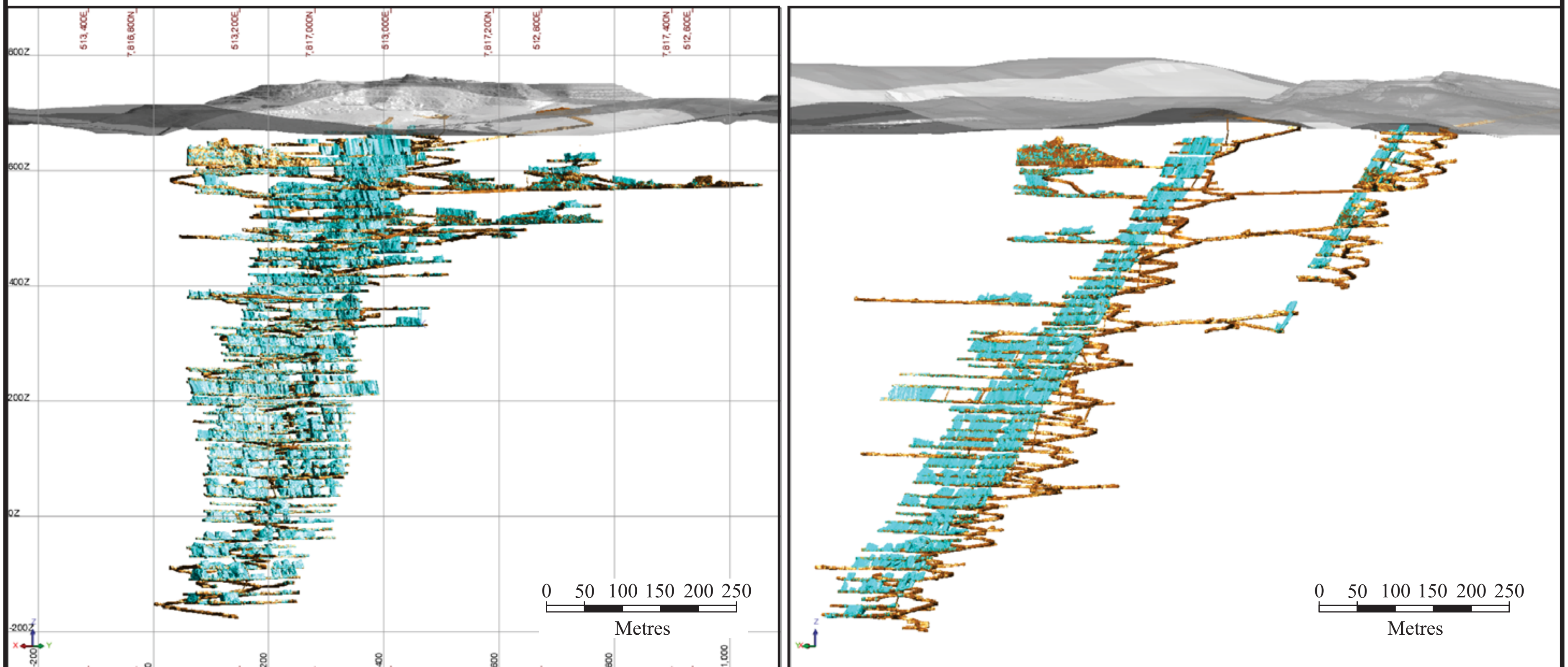
Domain Code	Name	Orebody
1	ANW	Orebody A - Portion NW
2	ASE	Orebody A - Portion SE
3	ASE02	Orebody A - Portion SE
4	ASE01-L01	Orebody A - Portion SE
5	ASE01-L02	Orebody A - Portion SE
6	ASE02	Orebody A - Portion SE
7	ASE03	Orebody A - Portion SE
8	AGRANADA	Orebody A - Portion SE - associated with Garnets
9	MVU	Ultramafic Hosted Zone
10	AXS-FW	Orebody A
11	AXS-HW	Orebody A
12	ANW-L01	Orebody A
15	B	Orebody B
16	BHW	Orebody B Hang wall
21-29	CSE	Orebody C - Portion SE
31-34	CCE	Orebody C - Center Portion - CE "Central"
41-43	CNW	Orebody C - Portion NW

TOPOGRAPHY AND EXCAVATION MODELS

A topographic surface of the immediate mine area that is current as of October 2013 was used to code the block model for those portions of Orebodies A, B, and C that have been excavated by means of open pit mining methods. Wireframe models of the completed underground development and stopes as of December 2018 were prepared and were used to code the block model for the portions of Orebodies A, B, and C that have been mined out (Figure 14-3). RPA recommends that the block model be coded using all of the mined out excavations available as a small number of blocks were not flagged properly.

Looking to Azimuth 220°

Looking to Azimuth 130°



Legend:
- *Stopes*
- *Development*

Figure 14-3

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Longitudinal and Projections Views of the Turmalina Mine Excavations

April 2019

Source: RPA, 2019.

SAMPLE STATISTICS AND GRADE CAPPING

The mineralization wireframe models were used to code the drill hole database and identify the resource related samples. These samples were extracted from the database into their respective domains, and then subjected to statistical analyses by means of histograms, probability plots, and decile analyses. A total of 105,061 samples were contained within the mineralized wireframes. The sample statistics are summarized in Table 14-6. Frequency histograms of the gold grade distribution are presented in Figures 14-4, 14-5, and 14-6.

TABLE 14-6 DESCRIPTIVE STATISTICS OF THE RAW GOLD ASSAYS
Jaguar Mining Inc. – Turmalina Mine Complex

	Orebody A		Orebody B		Orebody C	
Item	Uncapped	Capped	Uncapped	Capped	Uncapped	Capped
Length-Weighted Mean (g/t Au)	6.47	6.36	2.38	2.37	2.91	2.88
Median (g/t Au)	2.20	2.20	0.63	0.63	1.08	1.08
Mode (g/t Au)	0.01	0.01	0.01	0.01	0.01	0.01
Standard Deviation (g/t Au)	10.32	9.56	4.99	4.86	5.69	5.31
Coefficient of Variation	1.60	1.50	2.09	2.05	1.96	1.84
Sample Variance (g/t Au)	107.2	91.3	24.9	23.63	32.4	28.1
Minimum (g/t Au)	0.01	0.01	0.01	0.01	0.01	0.01
Maximum (g/t Au)	315.00	50.00	76.83	50.00	184.00	50.00
Count	61,098	61,098	16,506	16,506	27,457	27,457

FIGURE 14-4 FREQUENCY HISTOGRAM OF THE RAW GOLD ASSAYS, OREBODY A

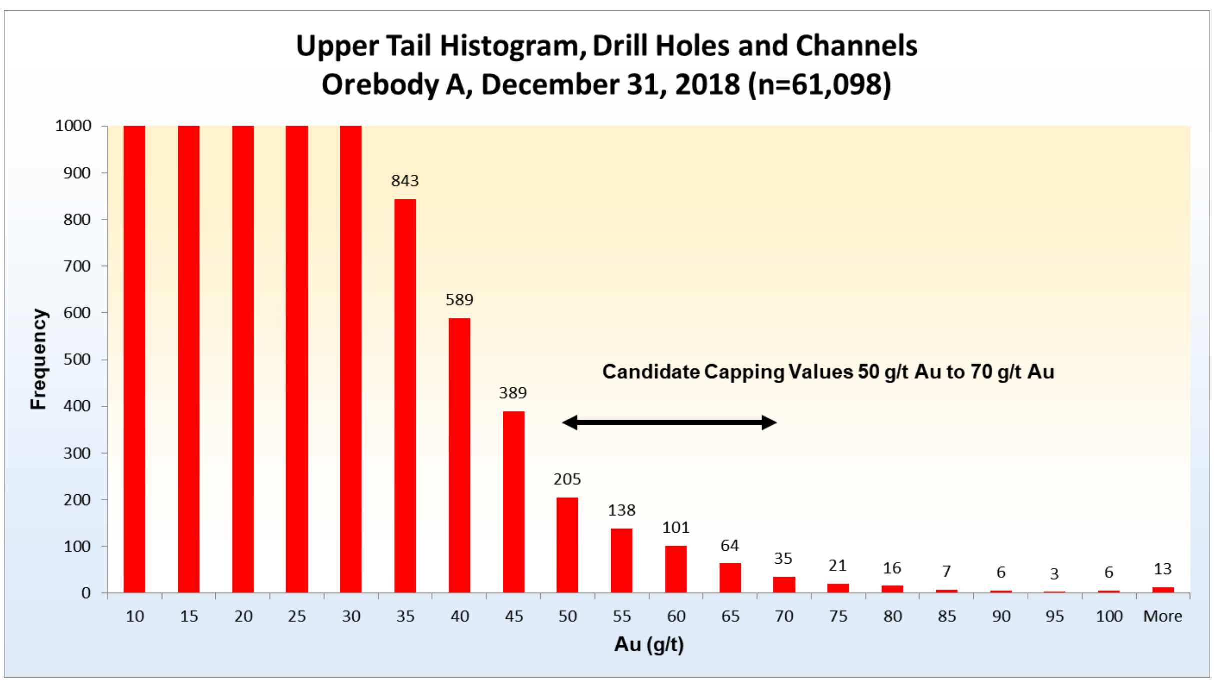


FIGURE 14-5 FREQUENCY HISTOGRAM OF THE RAW GOLD ASSAYS, OREBODY B

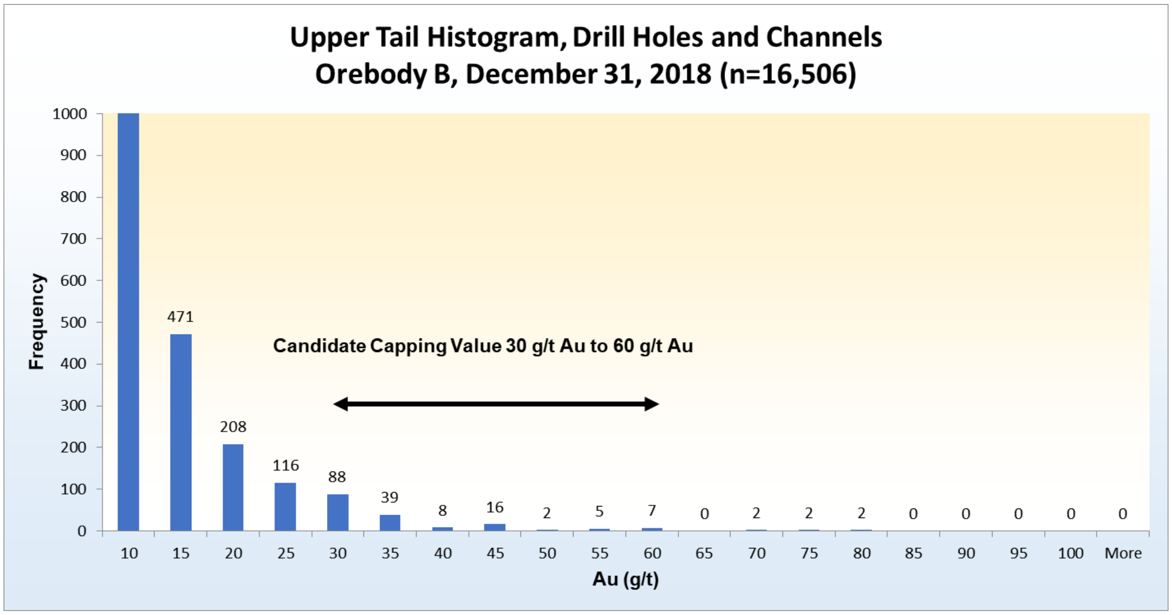
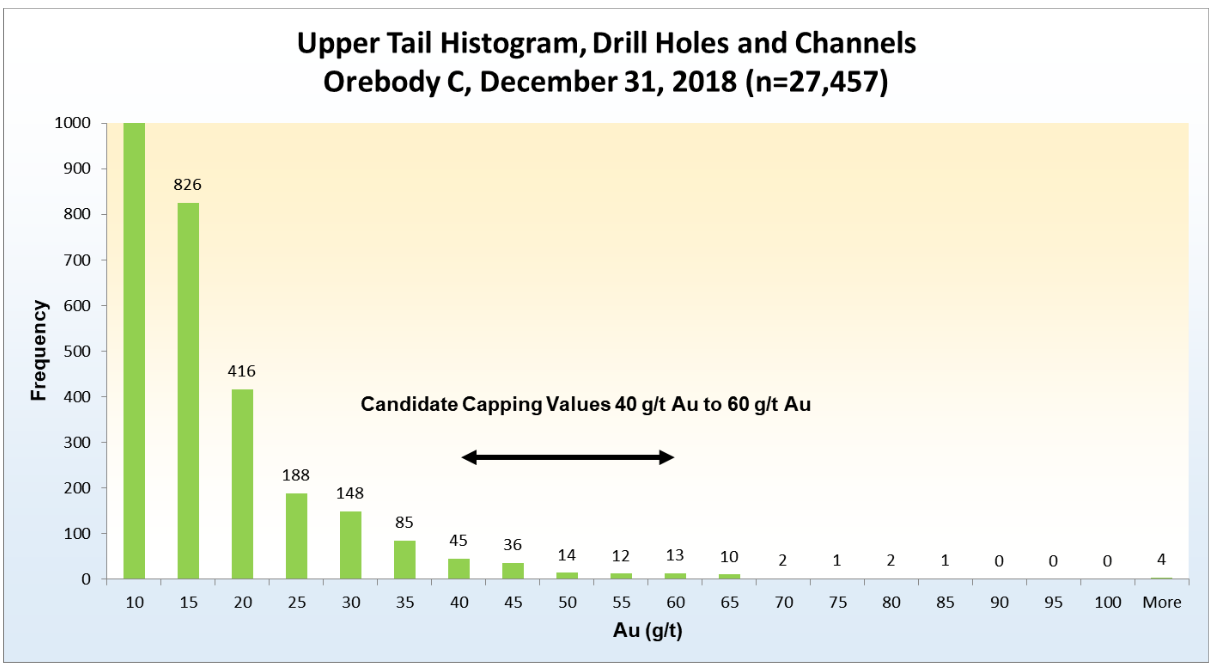


FIGURE 14-6 FREQUENCY HISTOGRAM OF THE RAW GOLD ASSAYS, OREBODY C



On the basis of its review of the assay statistics, RPA believes that a capping value of 50 g/t Au remains appropriate for each of the three orebodies, which is unchanged from the recommended capping values presented in RPA (2017). This capping value has been applied to all gold grades prior to creation of composited assay values.

RPA recommends that the capping values be re-examined in light of grade reconciliation information and adjusted as required.

COMPOSITING METHODS

The selection of an appropriate composite length began with examination of the descriptive statistics of the raw assay samples and preparation of sample length frequency histograms. Consideration was also given to the size of the blocks in the model. On the basis of the available information, RPA believes that a composite length of one metre for all samples is reasonable. This composite length remains unchanged from that described in RPA (2017). All samples contained within the mineralized wireframes were composited to a nominal one metre length using the best-fit function of the Hexagon HxGN MinePlan software package. The composite descriptive statistics are provided in Table 14-7.

TABLE 14-7 DESCRIPTIVE STATISTICS OF THE GOLD COMPOSITES
Jaguar Mining Inc. – Turmalina Mine Complex

	Orebody A		Orebody B		Orebody C	
Item	**Uncapped**	**Capped**	**Uncapped**	**Capped**	**Uncapped**	**Capped**
Length-Weighted Mean (g/t Au)	6.47	6.36	2.38	2.37	3.20	3.17
Median (g/t Au)	2.63	2.63	0.77	0.77	1.18	1.18
Mode (g/t Au)	0.01	0.01	0.01	0.01	0.01	0.01
Standard Deviation (g/t Au)	9.51	8.64	4.43	4.33	5.22	4.97
Coefficient of Variation	1.47	1.36	1.86	1.83	1.63	1.57
Sample Variance (g/t Au)	90.4	74.7	19.6	18.7	27.31	24.7
Minimum (g/t Au)	0.01	0.01	0.01	0.01	0.01	0.01
Maximum (g/t Au)	315.00	50.00	68.11	50.00	138.24	50.00
Count	38,795	38,795	10,081	10,081	18,280	18,280

BULK DENSITY

Jaguar continued its program of systematic determination of the bulk densities of the various mineralized zones through 2017 and 2018 using samples of ore and waste taken from drill holes. The bulk density values were determined by the water pycnometer method on selected pieces of drill core by Jaguar's laboratory staff at the Caeté site. The bulk density of 1,494 ore and waste samples from Orebodies A and C were determined (Table 14-8). Historical density data is available for Orebody B. The distribution of the density values are shown in Figures 14-7 and 14-8 for Orebodies A and C, respectively. The recent data confirm that the average bulk density for the mineralized material in both orebodies remains essentially unchanged from that presented in RPA (2017). The average density values for these mineralized wireframes were coded into the block model.

Examination of the distribution of the density measurements from the mineralized wireframes for Orebody A suggests that the distribution is approximately a Gaussian distribution centred on a mean value that is consistent with a silicate host rock. The distribution of density measurements from the mineralized wireframes for Orebody C suggests that while for the most part the density values are consistent with a silicate host rock, the presence of a weakly developed shoulder in the range of 3.1 t/m^3 to 3.4 t/m^3 suggests the presence of a second lithological unit of higher density. This could be due to the presence of an iron formation unit within the mineralized wireframes.

RPA recommends that geological mapping be carried out of all available underground excavations in the vicinity of the Orebody C mineralized wireframes. The results of this geological mapping should be used to prepare a lithological model to be used to improve the allocation of the density measurements for future Mineral Resource updates.

TABLE 14-8 SUMMARY OF DENSITY MEASUREMENTS BY OREBODY
Jaguar Mining Inc. – Turmalina Mine Complex

Material	No. Samples	Avg. Bulk Density (t/m^3)
	Orebody A:	
Mineralized	276	2.83
Waste	305	2.81
Sub-total	***581***	
	Orebody C:	
Mineralized	279	2.91
Waste	634	2.83
Sub-total	***913***	

FIGURE 14-7 HISTOGRAM OF BULK DENSITY MEASUREMENTS, OREBODY A MINERALIZED WIREFRAMES

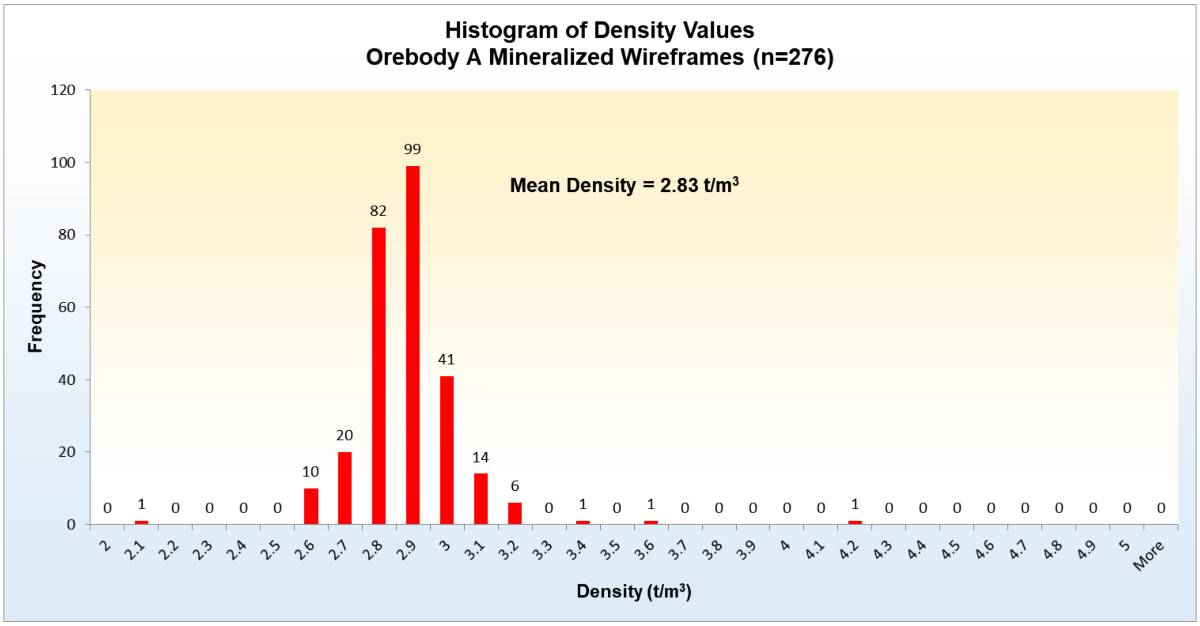
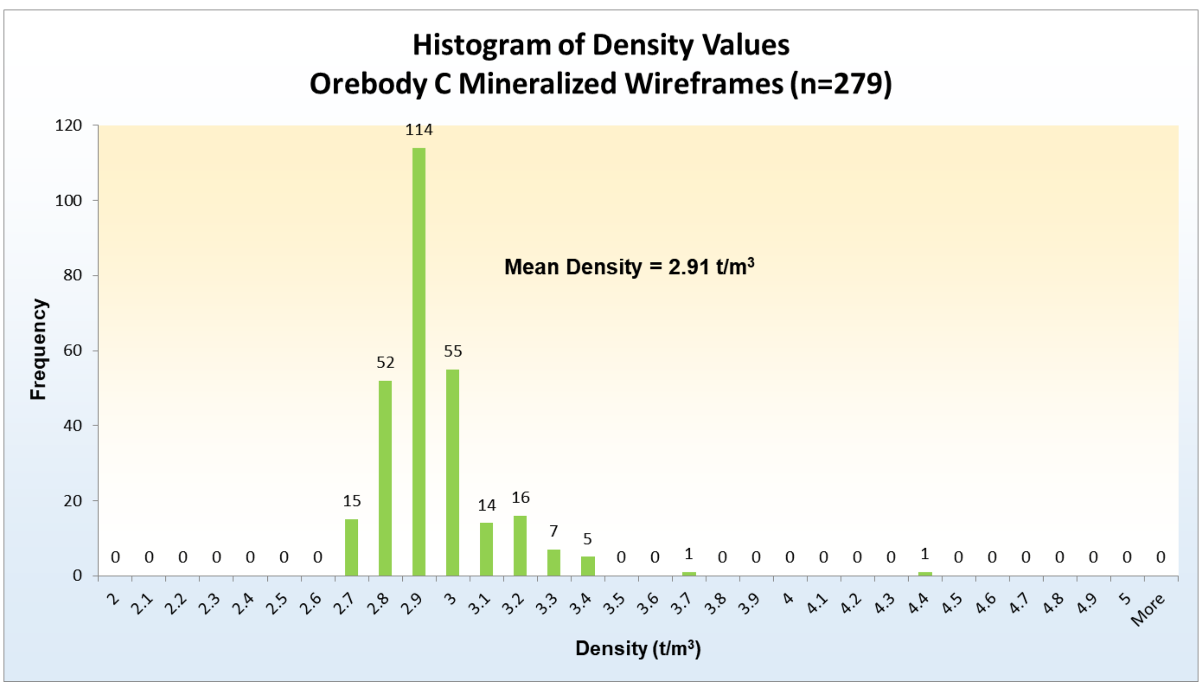


FIGURE 14-8 HISTOGRAM OF BULK DENSITY MEASUREMENTS, OREBODY C MINERALIZED WIREFRAMES



RPA recommends that additional bulk density measurements continue to be collected from any mineralized drill core samples in any future drilling programs.

TREND ANALYSIS

As an aid in carrying out variography studies of the distribution and continuity of the gold grades in the mineralized domain models, a short study to examine the overall trends was carried out for selected mineralized lenses. For this exercise, the gold values for each drill hole and channel sample contained within the respective mineralized lens were composited across the entire width of the wireframe and the resulting average grades were contoured using the Leapfrog software package (Figures 14-9 to 14-11).

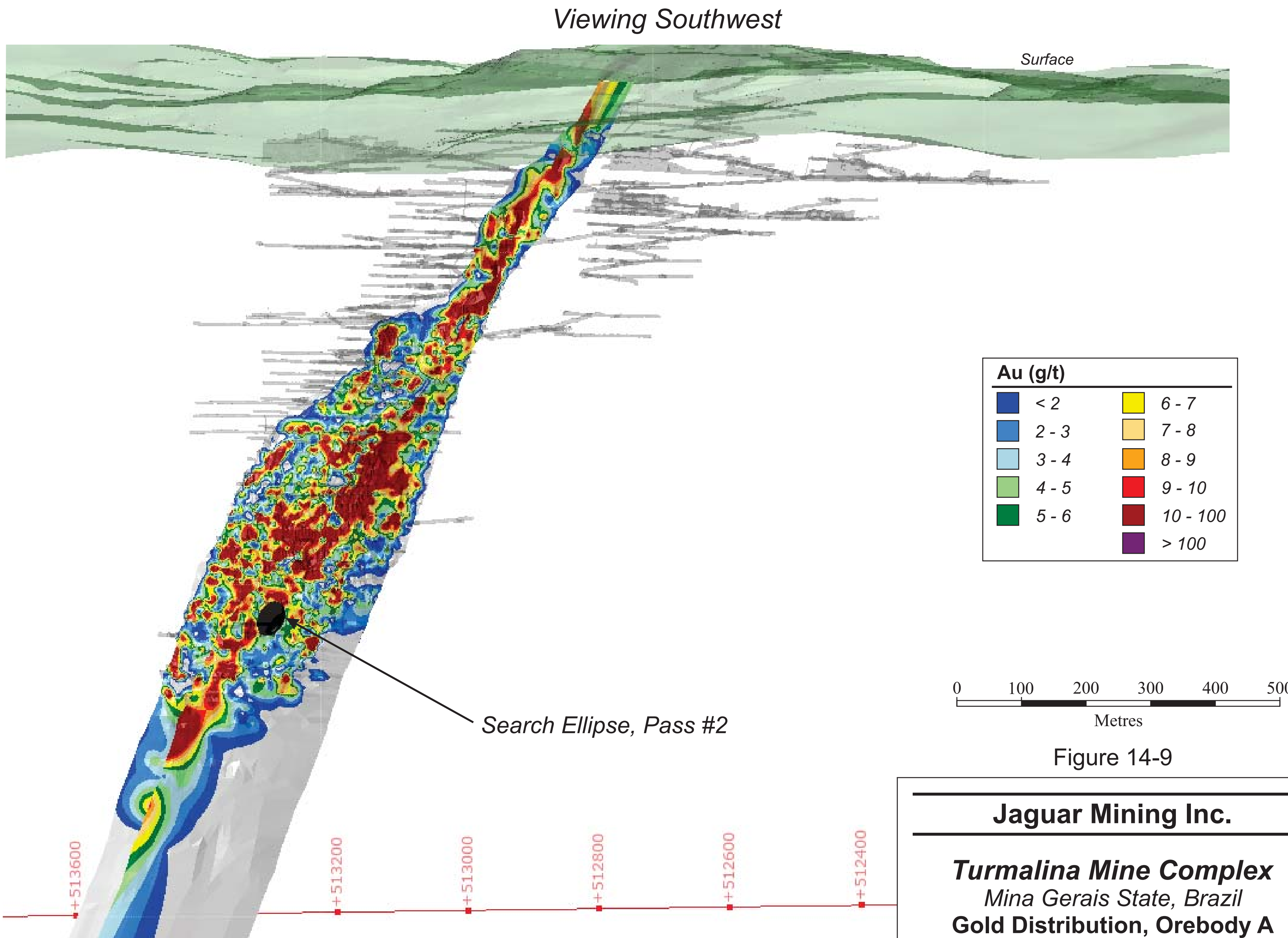


Figure 14-9

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Gold Distribution, Orebody A Hanging Wall and Fold Nose

April 2019

Source: RPA, 2019.

RPA

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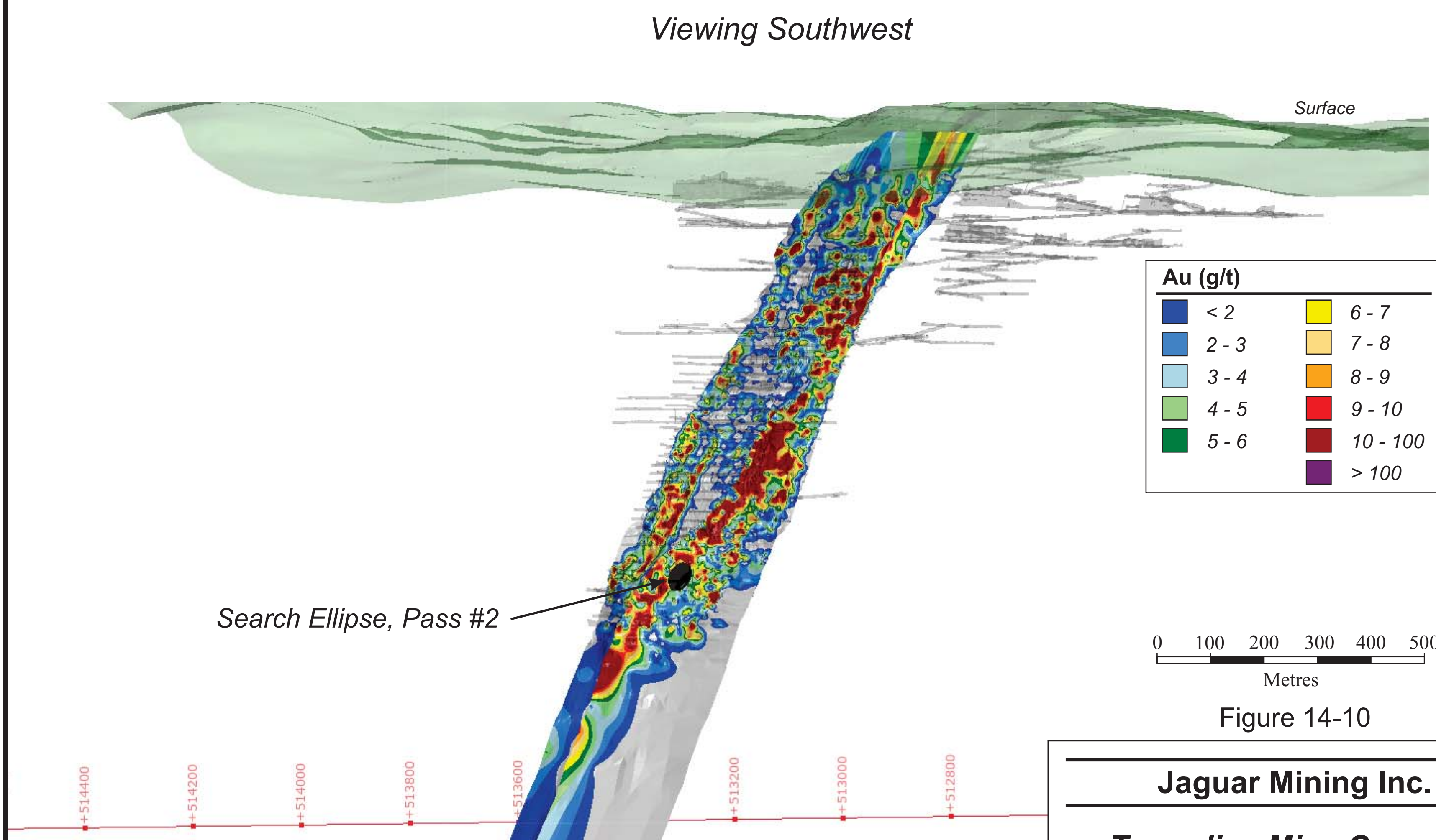

Figure 14-10

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Gold Distribution Orebody A Footwall and Fold Nose

April 2019

Source: RPA, 2019.

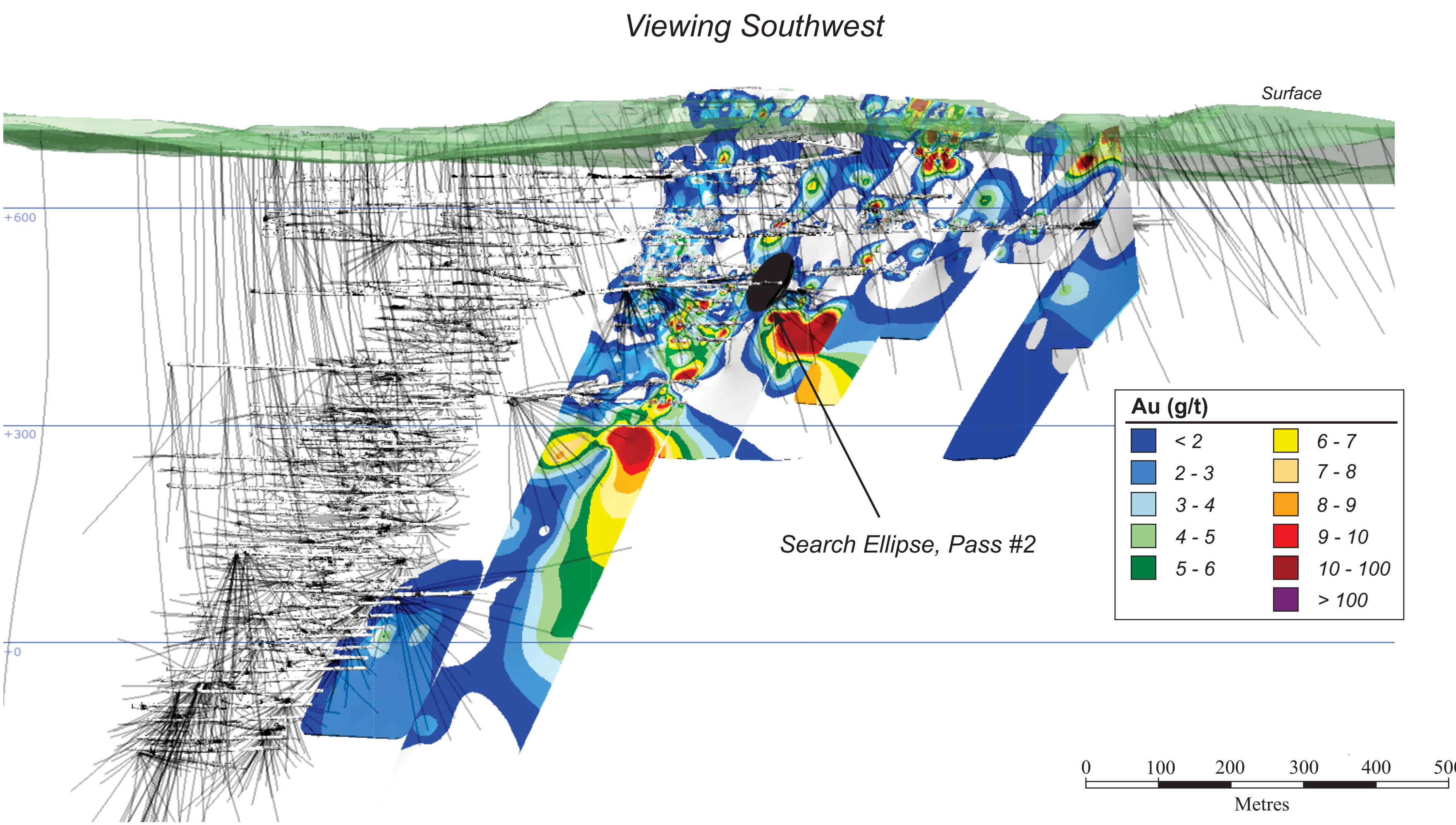

Figure 14-11

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Gold Distribution of a Portion of Orebody C (Lenses 21, 29, 31, 41, and 43)

April 2019

Source: RPA, 2019.

RPA

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The pronounced southeasterly down-plunge orientation of the higher grade gold grades initially discussed in RPA (2016) can be seen to persist in both the hanging wall and footwall limbs of Orebody A. The consistency of these trends may indicate the presence of an as-yet not understood structural or stratigraphic control on the distribution of the gold values for these zones. RPA recommends that studies be undertaken to examine the relationship of the gold values to structural, alteration, or lithologic features (such as the presence of quartz veining, for example) to aid in the understanding of the distribution of the higher grade gold values seen in Orebody A. The results from these studies will contribute not only towards arriving at an understanding of the controls on the distribution of the high grades, but are also expected to yield exploration targets for areas of the property which have not previously considered as being favourable for hosting potentially economic mineralization. As the lower limit of the gold mineralization clearly remains undefined below the deepest drill hole, additional work to outline the down-plunge continuation of the gold grades in Orebody A is clearly warranted.

In respect of Orebody C, the drilling and sampling activities completed in 2018 have been successful in locating and defining new pods of higher grade mineralization along the down-dip projection of the CSE and C-Central lenses as well as locating new mineralized lenses as discussed above. While some elongation of the higher grade gold values along the down-plunge direction is observed in the C-Central lens, high grade shoots are not as clearly defined at present as in Orebody A. Additional detailed sampling will be required to define the distribution of the higher grade gold values in detail. Additional work is clearly warranted to search for the down-dip limits of the gold mineralization not only of the CSE and C-Central lenses but beneath the northwest lenses of Orebody C (CNW) as well. RPA recommends that geological mapping, along with structural and alteration studies be undertaken to understand the nature of the gold mineralization and the structural and stratigraphic controls on the distribution of the gold values for Orebody C. The results of these studies will be of great use in understanding the controls on the distribution of the higher grade pods and will aid in developing exploration targets in this area of the mine property.

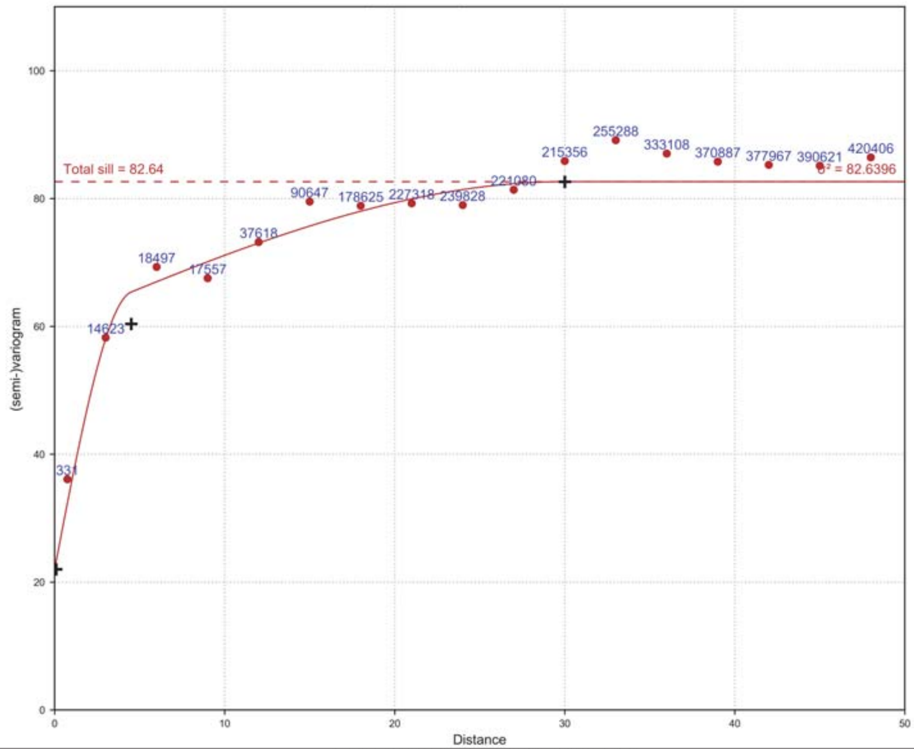
VARIOGRAPHY

Jaguar's geological team carried out an update analysis of the spatial continuity of the gold grades in Orebodies A, B, and C using all capped, composited drill hole and channel sample information contained within the respective mineralized wireframes as of the database crystallization date. Good model fits were obtained with the available data (Figures 14-12 and 14-13). The conclusions of that analysis remain effectively unchanged from the conclusions presented in RPA (2015). A summary of the variogram parameters derived for each of the three orebodies is presented in Table 14-9. RPA recommends that the spatial continuity of the gold grades in Orebodies A, B, and C be re-examined in light of the newly acquired understanding of the distribution of the gold grades for these three orebodies and amended as necessary.

TABLE 14-9 SUMMARY OF VARIOGRAPHY AND INTERPOLATION PARAMETERS
Jaguar Mining Inc. – Turmalina Mine Complex

	Orebody A			Orebody B	Orebody C		
Item	Phase 1	Phase 2	Phase 3		Phase 1	Phase 2	Phase 3
Nugget (C0)	22	22	22	5	8	8	8
Sill Major Axis (C1)	38.4	38.4	38.4	8.4	11	11	11
Sill Major Axis (C2)	22.2	22.2	22.2	5.8	3.54	3.54	3.54
Model Type	Sph.	Sph.	Sph.	Sph.	Sph.	Sph.	Sph.
Orientation (Az/Dip/Plunge)	050/-55/47	047/-55/40	058/-55/40	030/-65/40	060/-55/35	037/-58/40	051/-53/10
Anisotropy Ratio (Major/Semi-Major)	1.5	1.5	1.5	3.3	1.7	1.7	1.7
Anisotropy Ratio (Major/Minor)	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Number of Samples	3	3	3	3	3	3	3
Max. No. of Samples	16	16	16	16	16	16	16
Max No. of Samples per Hole	2	2	2	2	2	2	2
Max No. of Samples per Quadrant	4	4	4	4	4	4	4
Distances:							
Structure1 Major (m)	5	5	5	27	8	8	8
Structure1 Semi-Major (m)	4	4	4	4	7	7	7
Structure1 Minor (m)	3	3	3	3	5	5	5
Structure2 Major (m)	30	30	30	50	50	50	50
Structure2 Semi-Major (m)	20	20	20	15	30	30	30
Structure2 Minor (m)	6	6	6	10	10	10	10

Major Axis



Semi-Major Axis

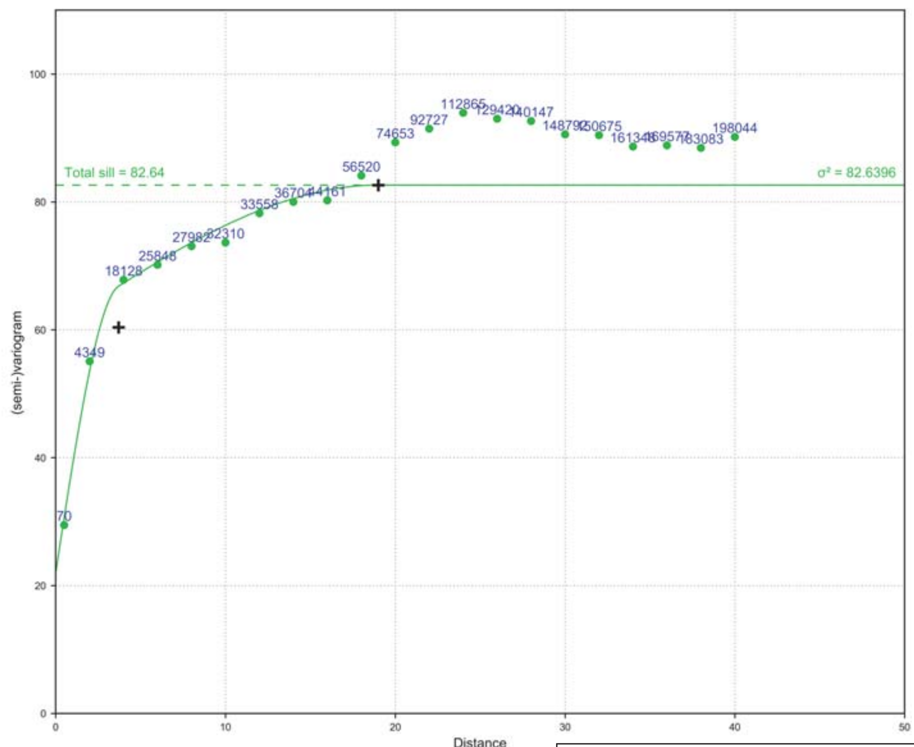


Figure 14-12

Jaguar Mining Inc.

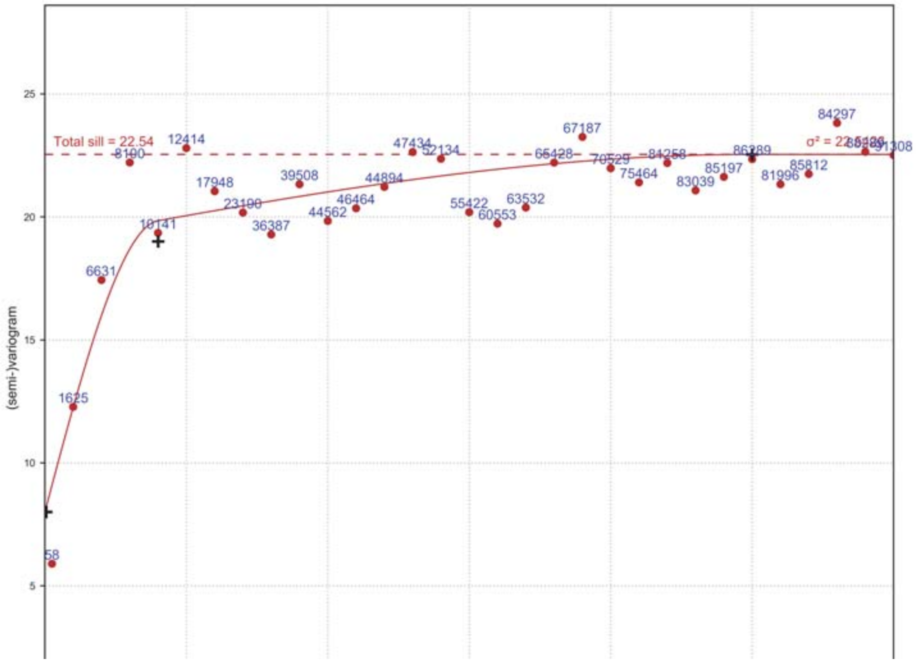
Turmalina Mine Complex

Minas Gerais State, Brazil

Major Axis and Semi-Major Axis Variograms, Orebody A

April 2019 ***Source: RPA, 2019.***

Major Axis



Semi-Major Axis

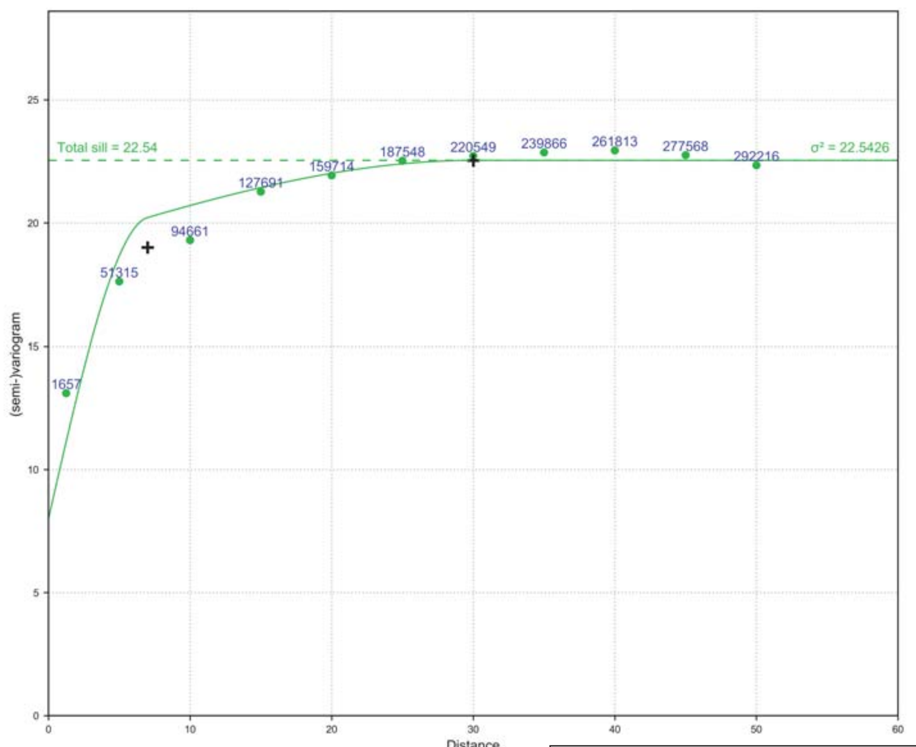


Figure 14-13

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Major Axis and Semi-Major Axis Variograms, Orebody C

April 2019

Source: RPA, 2019.

BLOCK MODEL CONSTRUCTION

The block model construction strategy was modified from what was previously employed at the Mine. The current block model was constructed using the Hexagon HxGN MinePlan software package and comprised an array of 4 m x 4 m x 4 m sized parent blocks using sub-blocking to a minimum block size of 1 m x 1 m x 1 m. The model is oriented parallel to the coordinate grid system (i.e., no rotation or tilt). The block sizes for this model were carefully selected so as to minimize the variation when compared with the block model strategy previously employed at the mine. The block model origin, dimensions, and attribute list are provided in Table 14-10. A number of attributes were created to store such information as rock code, material densities, estimated gold grades, mineral resource classification, mined out material, and the like (Table 14-11).

Gold grades were estimated into the blocks by means of inverse distance cubed (ID^3) and the ordinary kriging (OK) interpolation algorithms. A total of four interpolation passes at different ranges were carried out using distances derived from the variography results and the search ellipse parameters presented above. The orientations of the search ellipses were varied for Orebodies A and C so as to provide a better alignment with the three dimensional orientations of the individual mineralized wireframes. In total, three different search ellipse orientations (Phases 1 to 3) were used to estimate the gold grades for Orebody A. Three different search ellipse orientations were also used to estimate the gold grades for Orebody C. RPA recommends that the Jaguar team consider the use of a dynamic anisotropy method for estimation of gold grades into the model. The Jaguar team should also review the U-Fo estimation method as developed by the Advanced Laboratory for Geostatistical Supercomputing (ALGES), at the University of Chile in Santiago for preparing grade estimates for non-tabular mineralized zones.

In general, "hard" domain boundaries were used along the contacts of the mineralized domain models for all of the mineralized lenses. Only data contained within the respective wireframe model were allowed to be used to estimate the grades of the blocks within the wireframe in question, and only those blocks within the wireframe limits were allowed to receive grade estimates. The block grades were estimated in four estimation passes using the parameters presented in Table 14-12.

Due to the unique geometry of Orebody A, three sub-domains were created for the main mineralized lens. Domain ANW was created for the "nose" portion of the mineralized wireframe, and separate domains were created for the northern and southern "limbs" of the mineralization (ASE II and ASE, respectively). Soft boundaries were used for the composite data in these three sub-domains when interpolating the gold grades to permit a smooth transition of grades between the three sub-domains.

TABLE 14-10 BLOCK MODEL DEFINITION
Jaguar Mining Inc. – Turmalina Mine Complex

Type	Y (Northing)	X (Easting)	Z (Elevation)
Minimum Coordinates (m)	7,816,600	514,200	-600
Maximum Coordinates (m)	7,818,100	514,200	800
User Block Size (m)	4	4	4
Min. Block Size (m)	1	1	1
Rotation (°)	0.000	0.000	0.000

TABLE 14-11 LIST OF BLOCK MODEL ATTRIBUTES
Jaguar Mining Inc. – Turmalina Mine Complex

Variable Name	Description
Aui3c	Gold by Inverse Distance Cubed
auokc	Gold by Ordinary Kriging
avd	Average Distance of Informing Samples
class	Mineral Resource Classification (1=measured, 2=indicated, 3=inferred)
clod	Distance to Closest Informing Sample
dens	Material Density
mined	Mined out codes (-1=remaining, 1=mined out)
ndh	Number of Drill Holes for Estimation
nq	Number of Quadrants with Information
no_samp	Number of Informing Samples
ore_pct	Percent of Block Inside the Wireframe
pasok	Pass Number, Ordinary Kriging (1=Half of Variogram Range, 2=Variogram Range, 3=2x Range, 4=4x Range)
pasid	Pass Number, Inverse Distance (1=Half of Variogram Range, 2=Variogram Range, 3=2x Range, 4=4x Range)
rock	Material Code
topo_pct	Percent of Block Below Topography Surface
var	Variance

TABLE 14-12 SUMMARY OF THE ESTIMATION STRATEGY
Jaguar Mining Inc. – Turmalina Mine Complex

Parameters	Pass 1	Pass 2	Pass 3	Pass 4
Minimum No. of Composites	3	2	1	1
Maximum No. of Composites	16	16	16	16
Maximum No. Composites per Drill Hole	2	2	4	8
Maximum No. Composites per Quadrant	2	2	4	8
Minimum No. Quadrant with Composites	2	2	1	1

BLOCK MODEL VALIDATION

GLOBAL ESTIMATE

Validation of the estimated block model grades included a comparison of the average of all estimated block grades to the average of the composites (Table 14-13). In consideration of such items as the volume-variance effect, projection of estimated grades beyond the limits of the drill hole information and the effect of clustered data, the average estimated block grades agree reasonably well with the average grades of the informing composites.

TABLE 14-13 COMPOSITE VERSUS BLOCK GRADES BY OREBODY
Jaguar Mining Inc. – Turmalina Mine Complex

Item	Orebody A (g/t Au)	Orebody B (g/t Au)	Orebody C (g/t Au)
Composite Average	6.36	2.37	3.17
Block Grade Average	5.67	1.88	2.54

LOCAL ESTIMATE

A series of swath plots were prepared in which the average grade of the composites and the block grades were compared by elevation and by easting coordinate (Figures 14-14 and14-15).

Generally speaking, a good agreement between the estimated block grades and the informing composites is observed in areas where the density of the sample data is high, while greater variances are observed in those areas with limited channel or drill hole composites.

FIGURE 14-14 SWATH PLOT BY EASTING, ALL OREBODIES

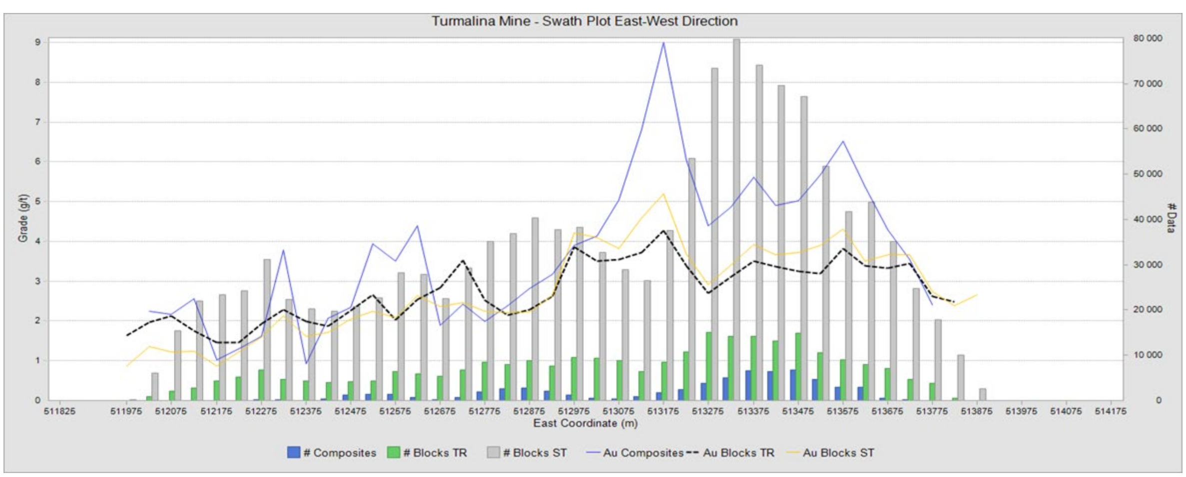
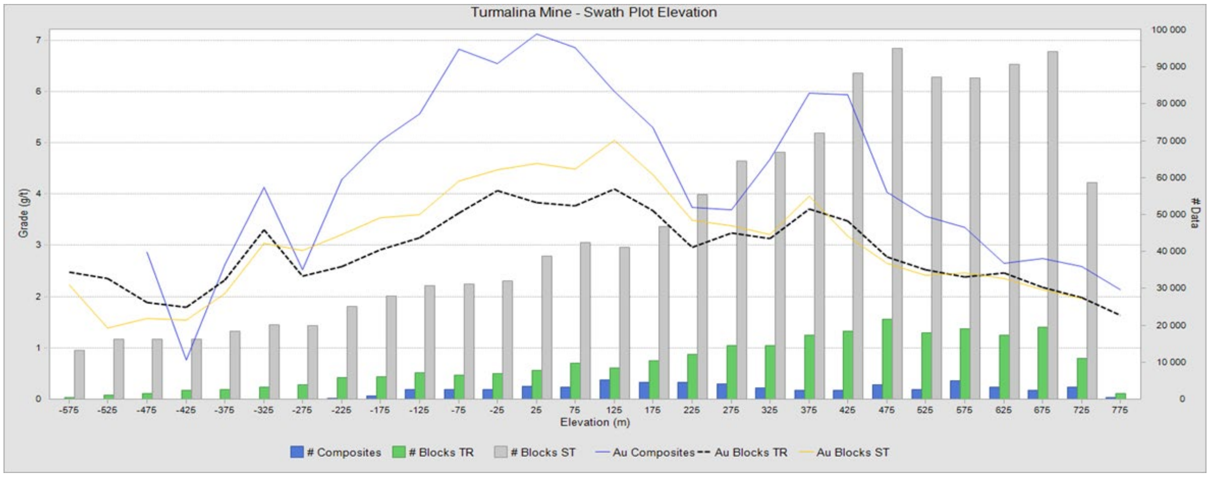


FIGURE 14-15 SWATH PLOT BY ELEVATION, ALL OREBODIES



Evaluation of the accuracy of the local estimate was also carried out by visually comparing the contoured gold grades against the estimated block grades in longitudinal views. Examples are presented in Figures 14-16, 14-17, and 14-18. While variances were observed at a local scale, in general a good correlation was observed for those areas of higher sample data density. A number of estimation artifacts were observed in several of the mineralized lenses in Orebody C for those areas of lower sample data density. RPA suspects that these artifacts are the result of the parameter selection for the search strategy for these lenses. RPA recommends that a short study be carried out to search for the optimum selection of input parameters to reduce the number of estimation artifacts for these mineralized lenses. The study should begin with the examination of the impact of the number of informing samples per quadrant on the resulting estimate. RPA also recommends that additional drill hole information be collected in these areas to improve the confidence level of the Mineral Resource estimate, to reduce and remove the estimation artifacts, and to search for the down-dip projections of the mineralization.

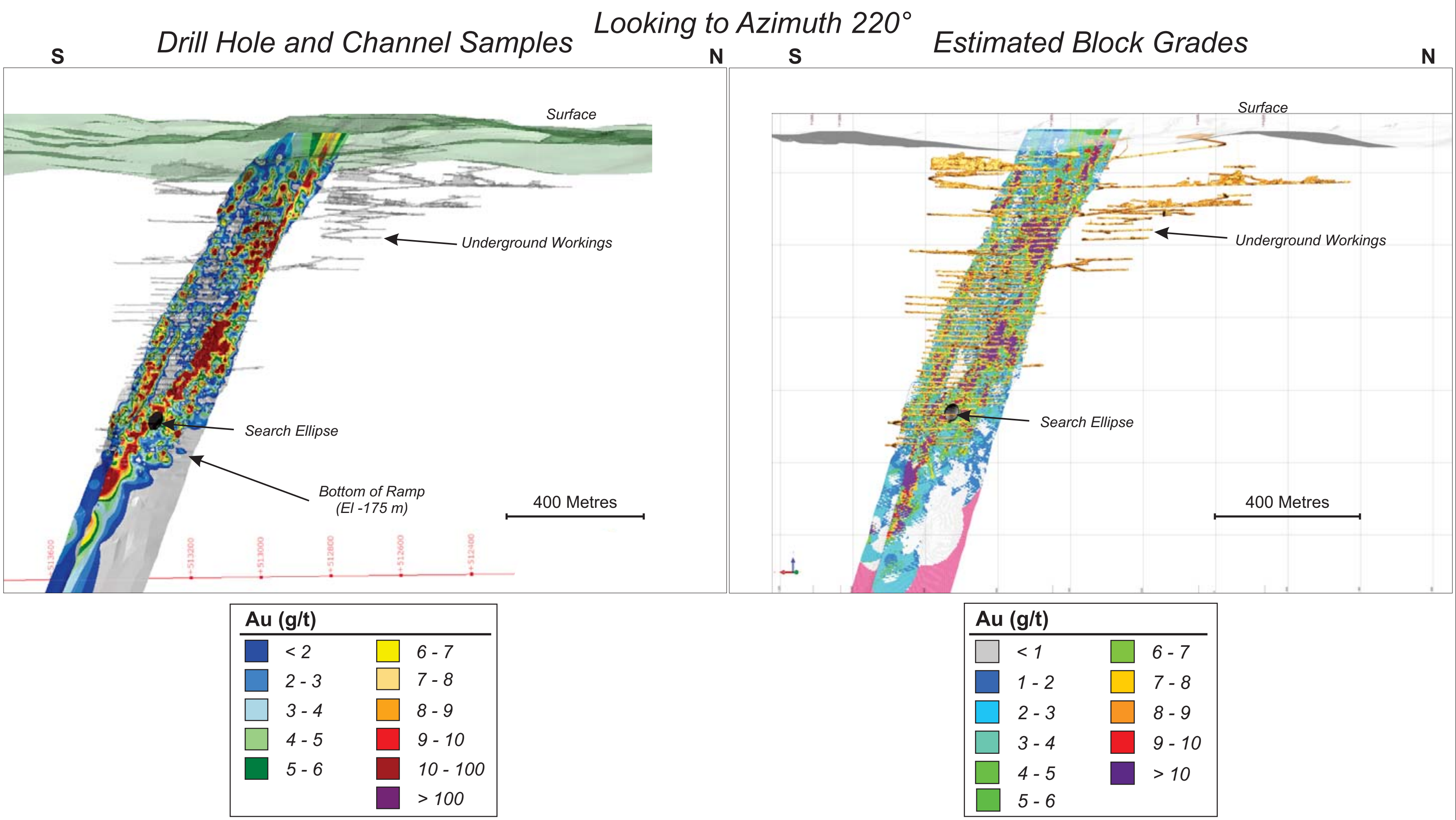


Figure 14-16

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Comparison of Contoured Gold Grades and Block Grades, Orebody A Fold Nose & Footwall

April 2019

Source: RPA, 2019.

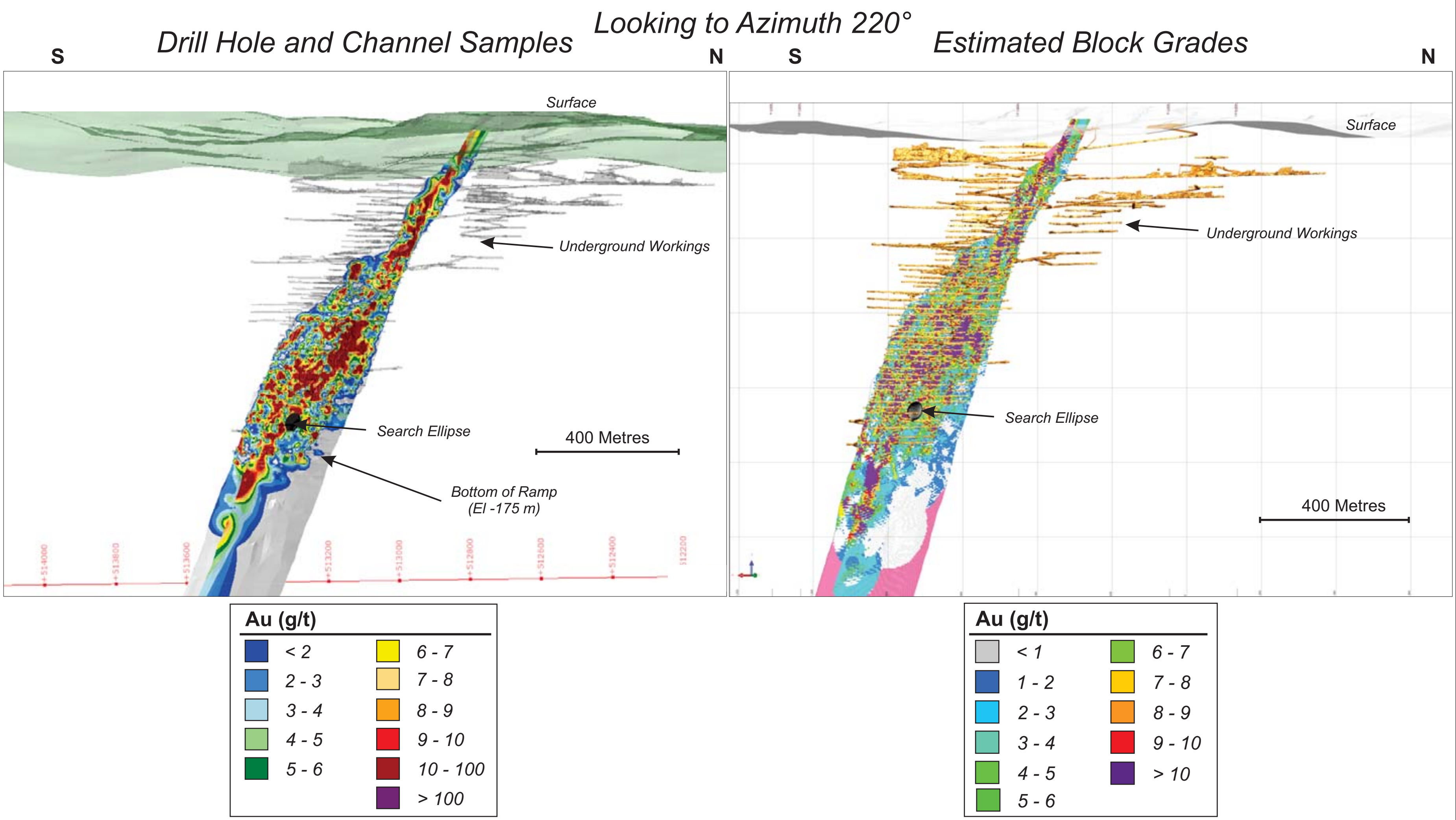


Figure 14-17

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Comparison of Contoured Gold Grades and Block Grades, Orebody A Fold Nose & Hanging Wall

April 2019

Source: RPA, 2019.

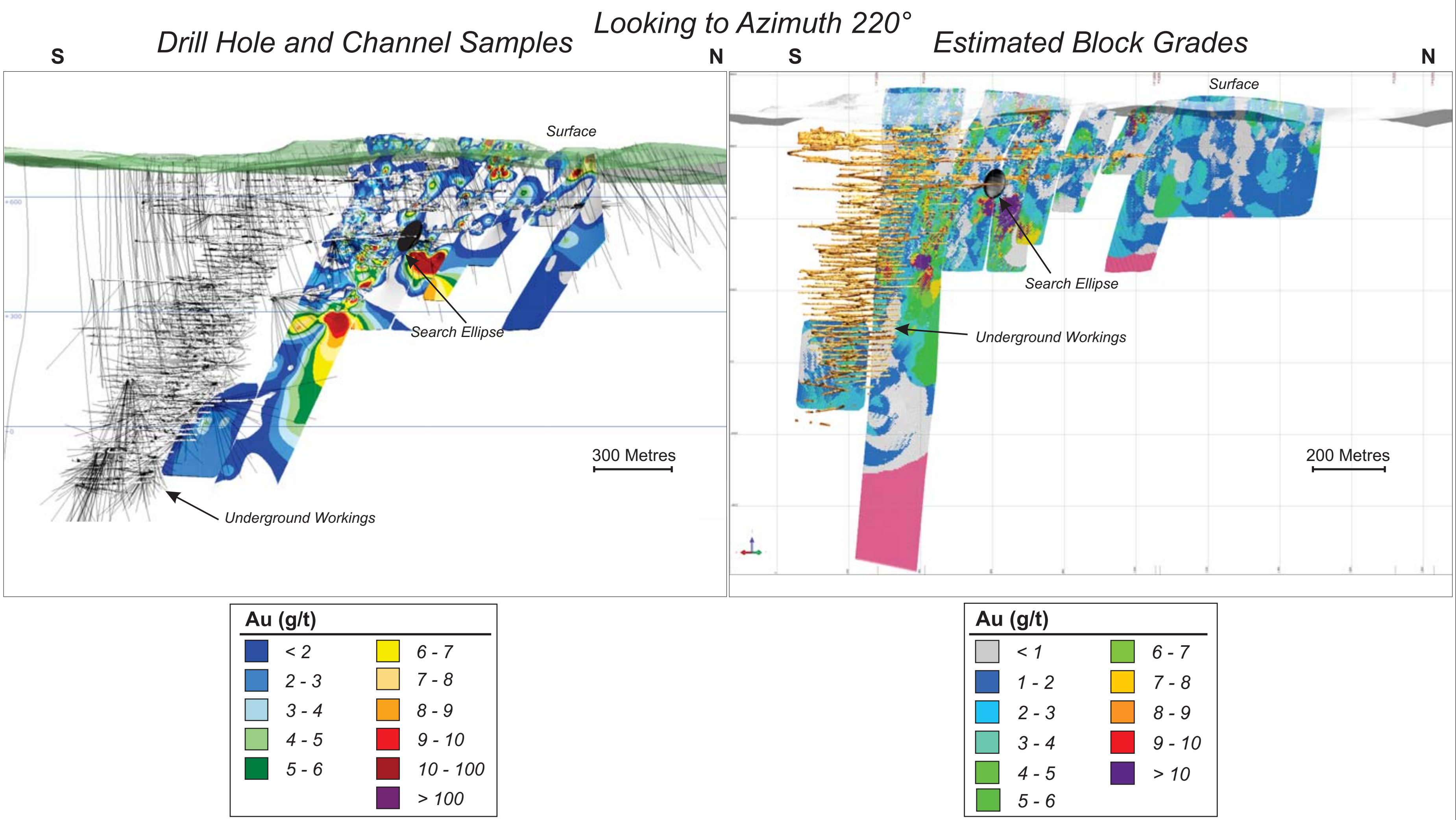


Figure 14-18

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Comparison of Contoured Gold Grades and Block Grades, Orebody C

April 2019

Source: RPA, 2019.

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RECONCILIATION

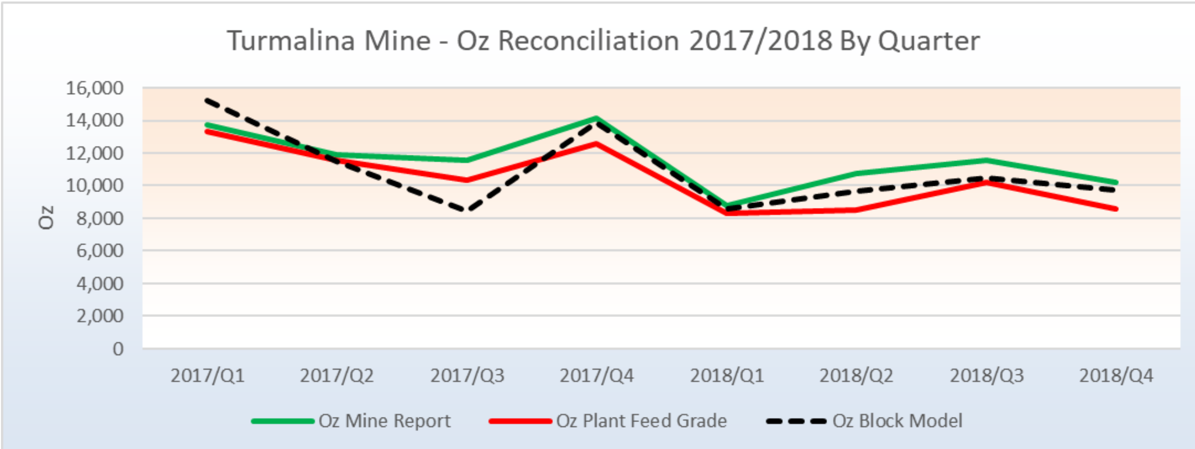
Validation exercises also consisted of comparing the revised block model estimated grades and tonnes against the 2017 and 2018 mine and plant production data on a quarterly basis (Table 14-14, Figure 14-19). In brief, the broken muck from the development headings and stopes is brought to surface and transported by truck to the stockpile area at the Turmalina plant. Samples are taken for each truck load to determine the grade of the material that was excavated from the mine. From the stockpile area, the broken muck is then fed into the plant.

The plant tonnages are derived from weightometer measurements on the feed belt and the plant feed grades are determined from direct sampling of material in the plant prior to the leaching circuit. The mine tonnages are derived from truck counts and the mine grade information is derived from stockpile samples. The trucks are tared on a daily basis. Considering that the updated block model incorporated all drill hole and channel sample information up to December 31, 2018, this comparison is closer to an F2 (Mine to Plant) reconciliation as described in Parker (2004) because the resource model has data support equivalent to a grade control model.

TABLE 14-14 QUARTERLY PRODUCTION, 2017 AND 2018
Jaguar Mining Inc. – Turmalina Mine Complex

Period	Mine Report			Plant Feed Grade			Block Model		
	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au
2017/Q1	111,261	3.84	13,739	113,346	3.65	13,308	103,321	4.57	15,189
2017/Q2	111,821	3.31	11,919	112,122	3.22	11,593	103,651	3.45	11,486
2017/Q3	107,174	3.36	11,589	106,629	3.02	10,346	90,528	2.89	8,410
2017/Q4	95,572	4.59	14,114	94,938	4.12	12,580	94,922	4.54	13,865
2018/Q1	80,805	3.38	8,775	81,145	3.19	8,333	74,150	3.60	8,582
2018/Q2	77,124	4.33	10,733	77,227	3.42	8,501	74,444	4.02	9,629
2018/Q3	89,667	4.01	11,566	88,173	3.61	10,230	82,447	3.95	10,460
2018/Q4	75,254	4.21	10,190	75,391	3.53	8,566	73,894	4.09	9,717
Total, 2017	**425,828**	**3.75**	**51,361**	**427,035**	**3.48**	**47,827**	**392,421**	**3.88**	**48,951**
Total, 2018	**322,850**	**3.97**	**41,263**	**321,936**	**3.44**	**35,630**	**304,935**	**3.92**	**38,388**

FIGURE 14-19 2017 AND 2018 RECONCILIATION INFORMATION BY QUARTER, CONTAINED OUNCES

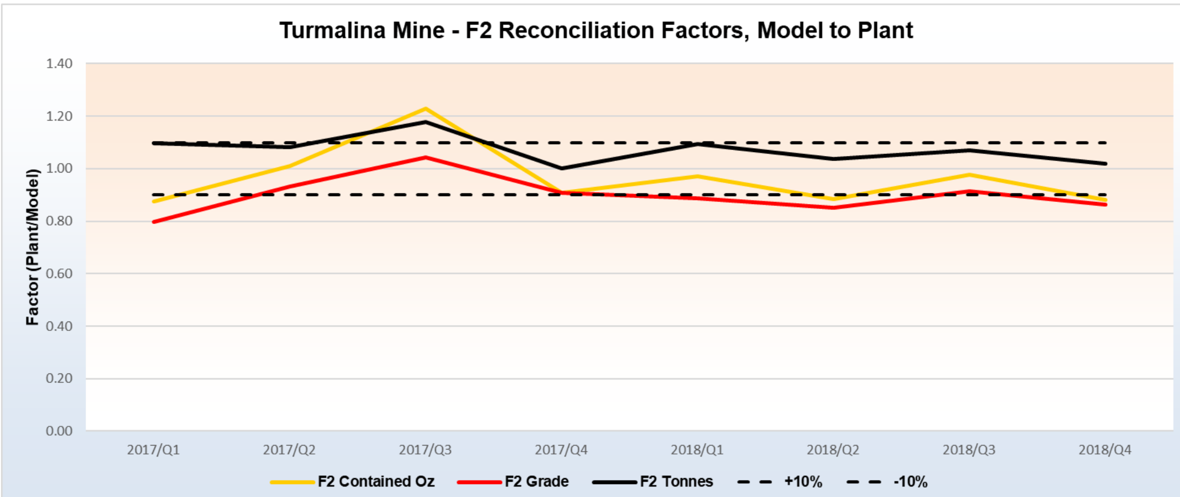


The monthly tonnage and grade figures derived from the year-end 2018 block model utilized the as-mined excavation solids models for the development and stopes completed in 2017 and 2018 to constrain the reports. The mined out volumes were created using data collected using a Cavity Monitoring Survey (CMS) and/or Total Station survey equipment. In a small number of cases, the shape and size of the excavated volumes could not be picked up due to equipment failures, timing, or safety issues. This is likely the main reason why the model tonnes are less than the mined tonnages in Table 14-14. RPA recommends that in these events where no CMS model is available for a given excavation volume, the design shape for the excavations in question be used as a proxy when preparing the reconciliation reports.

The grade of all blocks that are located outside of the mineralized wireframe models (ostensibly the waste materials) has been set to a value of zero for the 2018 block model. This approach will then result in the inclusion of all waste tonnes (both planned and unplanned dilution) along with the recovered ore tonnes. The data then represent the fully diluted, recovered tonnes and grade as predicted from the block model and so will be appropriate for comparison with plant feed grade. The quarterly F2 reconciliation results are presented in Figure 14-20.

In general terms, RPA observes that there is good agreement between the plant data and the block model for the 2017 and 2018 period. RPA is of the opinion that this agreement is suggesting that the sampling strategies, assaying methods, and estimation procedures currently used at the mine to prepare the grade block models are producing reasonable predictions of the tonnages, grades, and contained metal being received at the processing plant.

FIGURE 14-20 QUARTERLY F2 RECONCILIATION FACTORS, MODEL TO PLANT



The reconciliation information presented above utilizes the grade block model that was prepared using the drill hole and channel sample information that was available as of December 31, 2018. The estimated grades are then compared to the production information for the previous periods, thus allowing an analysis of the effectiveness of the sampling, assaying, and estimation protocols.

In order to obtain a view of the forward-predicting accuracy of these sampling, assaying and estimation protocols, the block model that was prepared using drill hole and channel sample information as of December 31, 2017 was used to compare the predicted tonnages and grade against the 2018 production statistics. The comparison of the predicted ounces is presented in Figure 14-21 and the F3 (Model to Plant) reconciliation factors are presented in Figure 14-22.

It can be seen that the accuracy of the year-end 2017 block model at predicting the amount of gold milled by the plant is in good agreement for the first quarter of 2018. The plant produced more gold in the remaining three quarters than was predicted from the block model. Review of the F3 reconciliation results shows that this is a result of an increase in the milled grade from that predicted by the block model.

FIGURE 14-21 GOLD PRODUCTION BY QUARTER, 2018

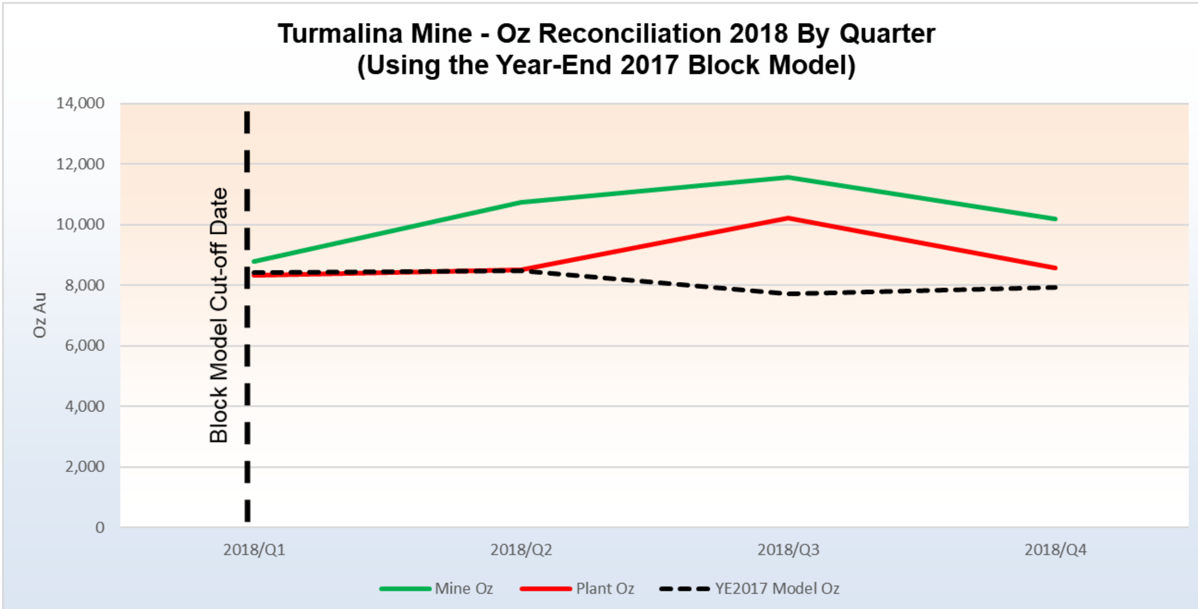
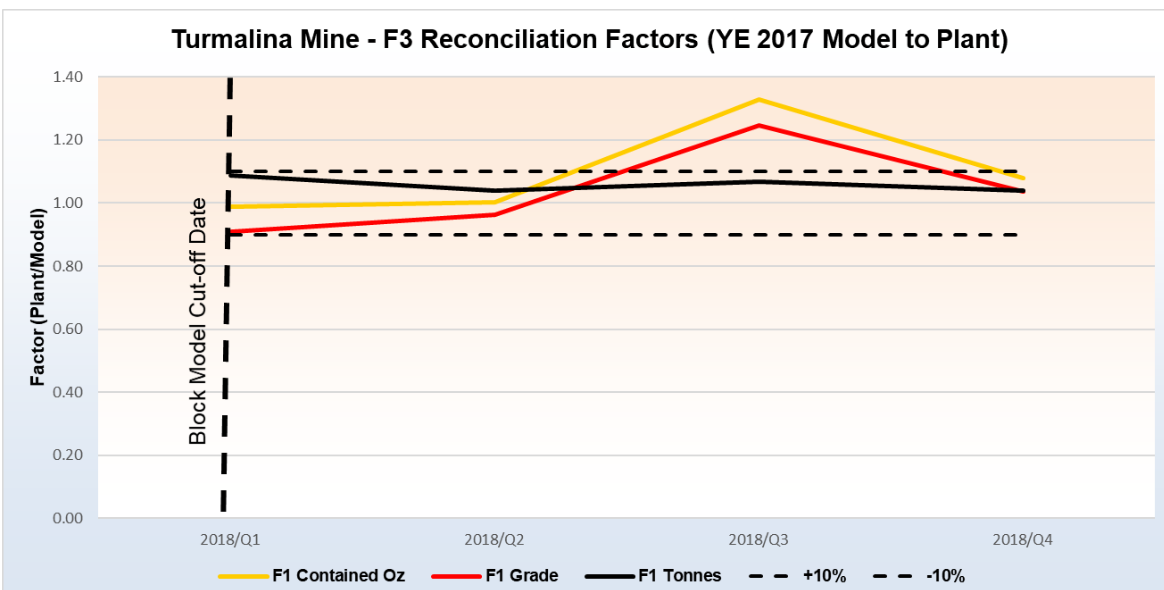


FIGURE 14-22 F3 RECONCILIATION FACTORS (YEAR-END 2017 MODEL TO PLANT)



MINERAL RESOURCE CLASSIFICATION CRITERIA

The Mineral Resources in this report were estimated in accordance with the definitions contained in CIM (2014).

The mineralized material for each wireframe was classified into the Measured, Indicated, or Inferred Mineral Resource category on the basis of the search ellipse ranges obtained from the variography study, the demonstrated continuity of the gold mineralization, the density of drill hole and chip sample information, and the presence of underground access.

On the basis of these criteria, Measured Mineral Resources comprise material that has been estimated using Pass #1 and that is located between developed levels. Indicated Mineral Resources comprise material that has been estimated using Pass #2, and Inferred Mineral Resources comprise material that has been estimated using Pass #3. Clipping polygons were used in a final stage of the classification process to ensure continuity and consistency of the classified blocks in the model.

CUT-OFF GRADE

A cut-off grade of 2.10 g/t Au is used for reporting of Mineral Resources at the Turmalina deposit. This cut-off grade was calculated using a gold price of US$1,500/oz, average gold recovery of 90%, and 2018 long-term cost data. Gold prices used for reserves are based on consensus, long term forecasts from banks, financial institutions, and other sources. For resources, gold prices used are slightly higher than those for reserves.

For the 2018 Mineral Resource estimate, Jaguar has used a cut-off grade of 0.50 g/t Au to prepare the interpreted outlines of the mineralized domains, which is below either the economic or incremental cut-off grades. RPA recommends that Jaguar use a stope incremental cut-off grade in future updates of the Mineral Resource estimate to better reflect the grades of the material that may be mined and processed.

MINERAL RESOURCE ESTIMATE

The Mineral Resources are inclusive of Mineral Reserves. For those portions of the Mineral Resources that comprise the Mineral Reserve, the stope design wireframes were used to constrain the Mineral Resource reports.

Additional Mineral Resources are present that reside beyond the Mineral Reserves. For these areas, clipping polygons were prepared to aid in the estimation of the Mineral Resources. The clipping polygons were prepared in either plan or longitudinal views, as appropriate. The clipping polygons were drawn to include continuous volumes of blocks whose estimated grades were above the stated cut-off grade, and were not located in mined out areas. The clipping polygons were used to appropriately code the block model and report the Mineral Resources. The Mineral Resources are presented in Table 14-15 and are shown in Figure 14-23. It is important to note that the Mineral Resources include remnant material for those areas in the upper portions of the mine where potentially economic grade material has been left behind. These areas were scrutinized and evaluated for their potential of being recoverable prior to being categorized as Mineral Resources.

TABLE 14-15 SUMMARY OF MINERAL RESOURCES AS OF DECEMBER 31, 2018 – TURMALINA DEPOSIT

Jaguar Mining Inc. – Turmalina Mine Complex

Category	Tonnage (000)	Grade (g/t Au)	Contained Oz Au (000)
Orebody A:			
Measured	894	6.86	197
Indicated	339	7.61	83
Sub-total M&I	**1,233**	**7.07**	**280**
Inferred	372	4.81	58
Orebody B:			
Measured	353	3.34	38
Indicated	192	4.26	26
Sub-total M&I	**545**	**3.66**	**64**
Inferred	18	6.46	4
Orebody C:			
Measured	520	4.20	70
Indicated	955	5.31	163
Sub-total M&I	**1,475**	**4.92**	**233**
Inferred	676	3.97	86
Total Turmalina Deposit:			
Total, Measured	1,767	5.37	305
Total, Indicated	1,486	5.69	272
Total Measured & Indicated	**3,253**	**5.52**	**577**
Total, Inferred	1,066	4.32	148

Notes:
1. CIM (2014) definitions were followed for Mineral Resources.
2. Mineral Resources are inclusive of Mineral Reserves.
3. Mineral Resources are estimated at a cut-off grade of 2.1 g/t Au for the Turmalina deposit.

4. Mineral Resources include all drill hole and channel sample data and mining excavations as of December 31, 2018.
5. Mineral Resources are estimated using a long-term gold price of US$1,500 per ounce.
6. Mineral Resources are estimated using an average long-term foreign exchange rate of 3.70 Brazilian Reais: 1 US Dollar.
7. A minimum mining width of approximately two metres was used.
8. Bulk density is 2.83 t/m^3 for Orebodies A and B and 2.91 t/m^3 for Orebody C at the Turmalina deposit.
9. Gold grades are estimated by the ordinary kriging interpolation algorithm using capped composite samples.
10. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
11. Numbers may not add due to rounding.

Categories of Inferred, Indicated, and Measured Mineral Resources are recognized in order of increasing geological confidence. However, Mineral Resources are not equivalent to

RPA is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other factors that could materially affect the Mineral Resource estimates.

It is RPA's opinion that the Turmalina deposit Mineral Resource estimate was prepared in a professional and diligent manner by qualified professionals and that the estimate complies with CIM (2014).

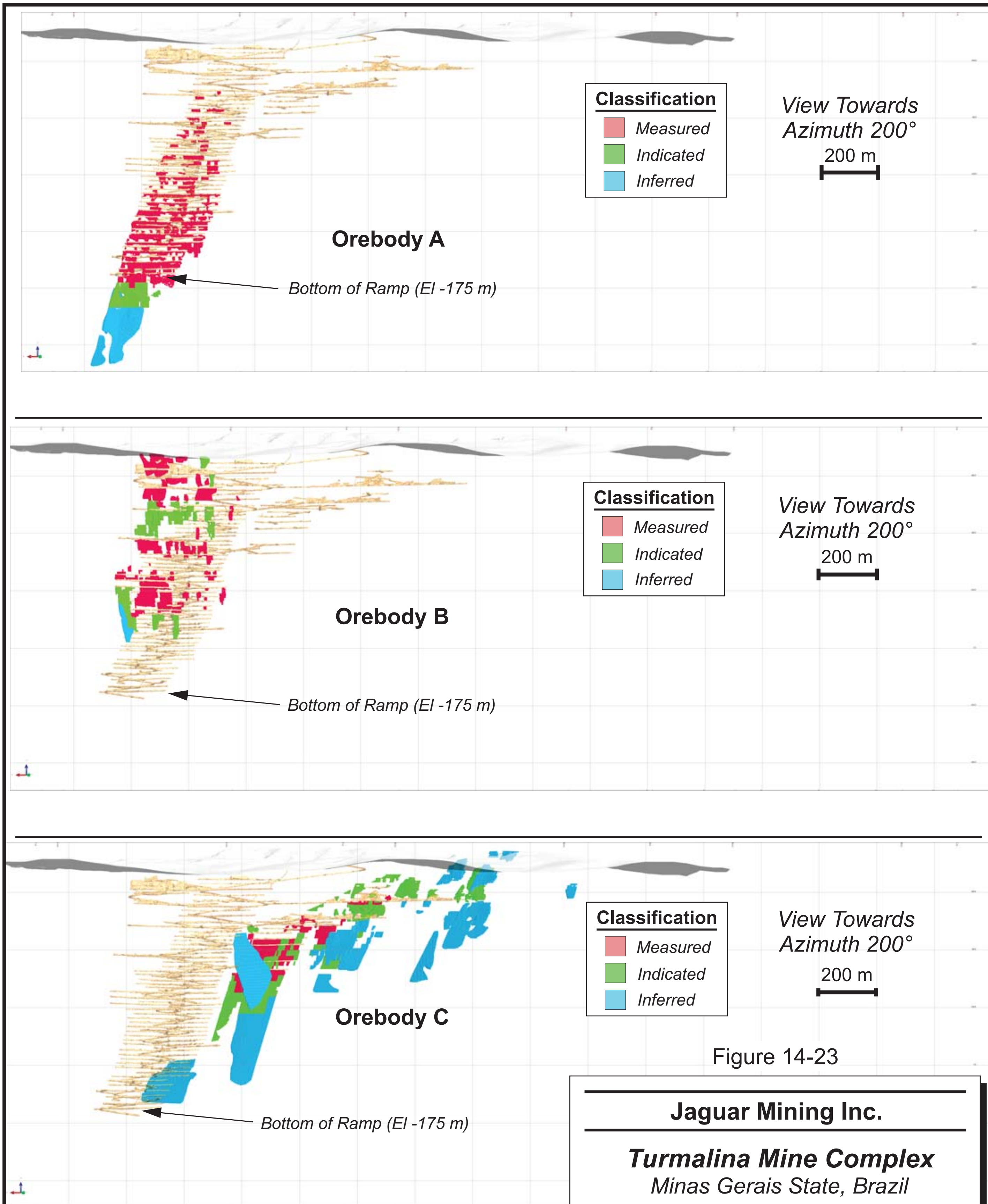


Figure 14-23

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Turmalina Mineral Resources as of December 31, 2018

April 2019

Source: RPA, 2019.

FAINA DEPOSIT

An updated Mineral Resource estimate for the Faina deposit was prepared in early 2015. A detailed description of the data and procedures to prepare the Mineral Resource estimate has been presented in RPA (2015). A summary of the salient items relating to that Mineral Resource estimate is presented below.

DATABASE

The drill hole database for the Faina deposit includes surface and underground drill holes along with surface trench and underground channel samples taken from the open pit and underground excavations, respectively. The drill hole and trench/channel sample data includes both historical-based samples collected by Mineração Morro Velho (MMV), a prior owner of the property, along with more recently completed drill holes and samples collected by Jaguar. In total, 3,992 diamond drill hole, chip, and trench samples were included in the drill hole database, along with a total of 47,667 assay records.

MINERALIZATION WIREFRAMES

The interpreted 3D wireframe models of the gold mineralization have been created using the assay values from surface and underground drill holes, channel sample data as available, and the detailed geological mapping information contained on the historical plan maps of the underground excavations. Wireframe models of the gold distribution were created using the Leapfrog Geo version 2.0.2 software package. The wireframe limits were drawn using a cut-off grade of 0.50 g/t Au and a nominal minimum width of 2.0 m.

A total of 39 individual wireframe models were created along a strike length of approximately 750 m and to a vertical depth of approximately 500 m from surface. In general, the wireframe models display a general northwest strike and plunge to the northeast at approximately 40°.

Wireframe surfaces were also created for oxidized and transitional weathering volumes using all available drill hole, channel, and trench sample information.

TOPOGRAPHY AND EXCAVATION MODELS

Two topography surfaces have been created that provide coverage over the area of the Faina deposit. The first surface represents the limit of open pit excavation, and was used to properly code the block model with the mined out volume. The second surface represents the current topography surface and accounts for the volume in the southeast portion of the mined out pit that was filled in with backfill material. The depth of the backfilled area is estimated at approximately 20 m.

A solid model of the underground excavation volume was created using existing centre-line survey data and a general arched cross section profile of 3 m x 3 m.

SAMPLE STATISTICS, GRADE CAPPING, AND COMPOSITES

The mineralization wireframe models were used to code the drill hole database and identify the resource-related samples. These samples were extracted from the database into their respective domains, and then subjected to statistical analyses by means of histograms, probability plots, capping curves, and decile analyses. A total of 12,419 samples were contained within the mineralized wireframes.

On the basis of its review of the assay statistics, RPA believes that a capping value of 30 g/t Au for channel samples and 25 g/t Au for drill hole samples is appropriate for each of the three domains at Faina - NW, Central, and SE.

The selection of an appropriate composite length began with examination of the descriptive statistics of the raw assay samples and preparation of frequency histograms. Consideration was also given to the size of the blocks in the model. On the basis of the available information, RPA believes that a composite length of one metre for all samples is reasonable. All samples contained within the mineralized wireframes were composited to a nominal one metre length using the best-fit function of the MineSight software package.

VARIOGRAPHY

Jaguar carried out an analysis of the spatial continuity by constructing separate omnidirectional variograms using the composites for each of the three domains, with the objective of determining an appropriate value for the global nugget (C0) using the MineSight software package. The analysis proceeded with the evaluation of any anisotropies that may be present in the data which resulted in successful variograms with reasonably good model fits for the down-plunge direction. Due to the spatial complexities inherent in the mineralized wireframe models, poor model fits were obtained for the along-strike and across-dip directions.

A summary of the variography and interpolation parameters for the Faina deposit is presented in Table 14-16.

TABLE 14-16 SUMMARY OF VARIOGRAPHY AND INTERPOLATION PARAMETERS – FAINA DEPOSIT
Jaguar Mining Inc. – Turmalina Mine Complex

Item	NW Domain	Central Domain	SE Domain
Nugget (C0)	5.0	6.0	4.0
Sill, Major Axis (C1)	5.45 (40 m)	4.28 (30 m)	6.62 (65 m)
Model Type	Spherical	Spherical	Spherical
Orientation*	070/-50/15	60/-55/-45 & 60/-55/60	60/-50/-25
Anisotropy Ratio (Major/Semi-Major)	2.67	1.88	1.91
Anisotropy Ratio (Major/Minor)	6.67	6.0	3.61
Minimum Number of Samples	3	3	3
Maximum Number of Samples	8	8	8
Maximum Number of Samples per Hole	2	2	2
Maximum Number of Samples per Quadrant	2	2	2

BLOCK MODEL CONSTRUCTION

The block model was constructed using the MineSight version 7.60 software package and comprised an array of 2 m x 2 m x 2 m sized blocks using a partial percentage attribute. The model is oriented parallel to the coordinate grid system (i.e., no rotation or tilt). The selection of the block size for this model was based upon the block size employed at the mine.

Gold grades were estimated into the blocks by means of ID^2, ID^3, OK, and nearest neighbour (NN) interpolation algorithms. A total of four interpolation passes were carried out using distances derived from the variography results and the search ellipse parameters presented above. Pass #1 used search ellipses that were one-half of the variogram ranges, Pass #2 used search ellipses with the variogram ranges as defined, Pass #3 used twice the variogram ranges, and Pass #4 used four times the variogram ranges. A single search ellipse orientation was used for the NW Domain and SE Domain, however, two search ellipse orientations were used for the Central Domain due to the complex spatial geometry in this area. The number of samples per quadrant was relaxed from two to one for passes #3 and #4, and the maximum number of composites per hole was relaxed from two to one for pass #4.

In general, "hard" domain boundaries were used along the contacts of each of the 39 individual mineralized domain models. Only data contained within the respective individual wireframe model were allowed to be used to estimate the grades of the blocks within the wireframe in question, and only those blocks within the wireframe limits were allowed to receive grade estimates.

CUT-OFF GRADE

The conceptual operational scenarios considered during preparation of previous Mineral Resource estimates envisioned that the fresh, unoxidized mineralization from the Faina deposit would be excavated on a satellite deposit basis and transported by truck to the existing Turmalina plant for processing. Preliminary metallurgical tests have been completed on samples of fresh, unoxidized mineralization from the Faina deposit from that conceptual perspective. They have yielded unacceptably low recoveries when the material is considered as potential feed to the existing Turmalina plant, and it has been concluded that the mineralization at the Faina deposit is refractory. While the arsenical nature of the mineralization at Faina is suspected to play a role in the poor recoveries, RPA believes that the testwork completed to date has not definitively supported this conclusion.

An alternative conceptual operational scenario was developed for the 2015 Mineral Resources in which the mineralized material will be excavated by means of underground mining methods and transported to the Turmalina plant for processing. A gold-rich flotation concentrate is envisioned to be generated after appropriate upgrades have been made to the existing plant. The gold-rich flotation concentrate would then be shipped or sold to a domestic source for recovery of the gold.

Input parameters to the estimate of an appropriate reporting cut-off grade considered this revised conceptual operating scenario along with the potential mining methods that are suitable for the narrow widths, short strike-length lenses, and highly convoluted nature of the mineralized wireframes at the Faina deposit. Consideration was also given to the actual costs incurred at the Turmalina plant where appropriate.

A cut-off grade of 3.8 g/t Au is used for reporting of Mineral Resources. This cut-off grade was calculated using a gold price of US$1,400/oz, average gold recovery of 85% to flotation concentrate, 2014 actual cost data for the Turmalina Mine, along with estimated transportation and treatment charges. The gold prices used for resources are based on consensus, long term forecasts from banks, financial institutions, and other sources. RPA believes that the stated cut-off grade remains reasonable considering the relatively stable Mineral Resource cut-off grades at the Turmalina Mine between 2014 and 2018.

MINERAL RESOURCE ESTIMATE

At the Faina deposit, the Mineral Resources are dominated by fresh, unoxidized material, but also contain a small proportion of oxide- and transition-hosted weathered material.

At a cut-off grade of 3.8 g/t Au, the Mineral Resources at the Faina deposit total 261,000 tonnes at an average grade of 6.87 g/t Au containing 57,500 ounces of gold in the Measured and Indicated Mineral Resource category and 1,542,000 tonnes at an average grade of 7.3 g/t Au containing 360,200 ounces of gold in the Inferred Mineral Resource category (Table 14-17). RPA recommends that the Mineral Resource estimate for the Faina deposit be re-evaluated if any material changes occur to the values of the cut-off grade input parameters.

No Mineral Reserves are present at the Faina deposit.

TABLE 14-17 SUMMARY OF MINERAL RESOURCES AS OF DECEMBER 31, 2014 – FAINA DEPOSIT
Jaguar Mining Inc. – Turmalina Mine Complex

Category	Tonnes (000)	Grade (g/t Au)	Contained Oz Au (000)
		Oxide	
Measured	11	6.81	2
Indicated	7	6.48	2
Sub-total M&I	**18**	**6.68**	**4**
Inferred	3	5.65	1
		Transition	
Measured	5	6.65	1
Indicated	3	6.20	1
Sub-total M&I	**8**	**6.48**	**2**
Inferred	2	6.30	0
		Fresh	
Measured	56	7.51	14
Indicated	179	6.85	39
Sub-total M&I	**235**	**6.88**	**52**
Inferred	1,537	7.27	359
		Total: Oxidized, Transition and Fresh	
Measured	72	7.39	17
Indicated	189	6.66	42
Sub-total M&I	**261**	**6.87**	**58**
Inferred	1,542	7.26	360

Notes:
1. CIM (2014) definitions were followed for Mineral Resources.
2. Mineral Resources are estimated at a cut-off grade of 3.8 g/t Au.
3. Mineral Resources are estimated using a long-term gold price of US$1,400 per ounce.
4. Mineral Resources are estimated using an average long-term foreign exchange rate of 2.5 Brazilian Reais: 1 US Dollar.
5. A minimum mining width of two metres was used.
6. Bulk density is 1.70 t/m^3 for oxidized material, 2.25 t/m^3 for transition, and 2.85 t/m^3 for fresh, un-weathered material.
7. Gold grades are estimated by the inverse distance cubed interpolation algorithm.
8. No Mineral Reserves exist for the Faina deposit.
9. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
10. Numbers may not add due to rounding.

PONTAL DEPOSIT

An updated Mineral Resource estimate for the Pontal deposit was prepared in early 2015. A detailed description of the data and procedures to prepare the Mineral Resource estimate has been presented in RPA (2015). A summary of the salient items relating to that Mineral Resource estimate is presented below.

DATABASE

The drill hole database for the Pontal deposit includes surface and underground drill holes along with surface trench samples and underground channel samples. The drill hole and trench/channel sample data includes both historical-based samples collected by MMV, a prior owner of the property, along with more recently collected samples taken by Jaguar. In total, 3,590 DDH, chip, and trench samples were included in the drill hole database, along with a total of 17,043 assay records.

MINERALIZATION WIREFRAMES

The interpreted 3D wireframe models of the gold mineralization have been created using the assay values from surface and underground drill holes, trench and channel sample data as available, and the detailed geological mapping information contained on the historical plan maps of the underground excavations. The gold values are hosted in two principal deposits known as LB1 and LB2.

Wireframe models of the gold distribution were updated using the MineSight v.7.60 software packages. The wireframe limits were drawn using a cut-off grade of 0.50 g/t Au and a nominal minimum width of 2.0 m. The wireframe models were clipped to the as-mined surface. A total of 16 individual wireframe models were created, including seven wireframes for the LB1 deposit and nine wireframes for the LB2 deposit.

In general, the LB1 wireframe models measure approximately 250 m x 250 m in plan view and continue downwards to a vertical depth of approximately 300 m from surface. The mineralization at the LB1 deposit has been traced by drilling along a dip of approximately -60° to the east.

The mineralization wireframes at the LB2 deposit display a general northwesterly strike of approximately 335° and have been traced by drill hole and trench sampling along a strike length of approximately 300 m. The wireframes generally dip at approximately -45° to the northeast and extend to a depth of approximately 100 m from surface.

Wireframe surfaces were also created for oxidized and transitional weathering volumes using all available drill hole, channel, and trench sample information.

TOPOGRAPHY AND EXCAVATION MODELS

Two topography surfaces were created that covered the local area of each of the two deposits using contour lines from available topography maps along with local spot heights derived from the locations of any drill hole or trench sample data.

An approximation of the underground excavations was created by digitizing the outlines in plan view from historical underground mapping and sampling programs carried out at the LB1 deposit. The digitized plan view strings were projected upwards by a constant distance of 2.5 m to create the solid model of the underground excavations. In total, two levels were excavated – the upper level was excavated at a toe elevation of approximately 609 m and the lower level was excavated at a toe elevation of approximately 603 m.

SAMPLE STATISTICS, GRADE CAPPING, AND COMPOSITES

The mineralization wireframe models were used to code the drill hole database and identify the resource-related samples. These samples were extracted from the database into their respective domains, and then subjected to statistical analyses by means of histograms, probability plots, capping curves, and decile analyses. A total of 6,569 samples were contained within the LB1 mineralized wireframes and a total of 1,308 samples were contained within the LB2 mineralized wireframes.

On the basis of its review of the assay statistics, RPA believes that a capping value of 30 g/t Au is appropriate for the LB1 wireframes and a capping value of 10 g/t Au is appropriate for the LB2 wireframes. The selection of an appropriate composite length began with examination of the descriptive statistics of the raw assay samples and preparation of frequency histograms. Consideration was also given to the size of the blocks in the model. On the basis of the available information, RPA believes that a composite length of one metre for all samples is reasonable. All samples contained within the mineralized wireframes were composited to a nominal one metre length using the best-fit function of the MineSight software package.

VARIOGRAPHY

Jaguar verified the analysis of the spatial continuity of the mineralization contained within the LB1 wireframe models as presented in Machado (2011) using the variography package contained in the SGeMS software package. Its work resulted in construction of a successful omnidirectional variogram using the composite data. The analysis proceeded with the evaluation of any anisotropies that may be present in the data which resulted in a successful variogram with reasonably good model fits for the down-plunge direction.

Unfortunately, no successful model fits were possible for the LB2 deposit due to the lack of sufficient sample pairs.

A summary of the variography and interpolation parameters for the two deposits is presented in Table 14-18.

TABLE 14-18 SUMMARY OF VARIOGRAPHY AND INTERPOLATION PARAMETERS – PONTAL DEPOSIT
Jaguar Mining Inc. – Turmalina Mine Complex

Item	LB1 Deposit	LB2 Deposit
Nugget (C0)	3.0	3.0
Sill, Major Axis (C1)	2.9 (90 m)	2.9 (30 m)
Model Type	Spherical	Spherical
Orientation*	115/-60/-15	0/0/0
Anisotropy Ratio (Major/Semi-Major)	2.37	1.0
Anisotropy Ratio (Major/Minor)	9.0	3.0
Minimum Number of Samples	3	3
Maximum Number of Samples	8	8
Maximum Number of Samples per Hole	2	2
Maximum Number of Samples per Quadrant	2	2

BLOCK MODEL CONSTRUCTION

The block model was constructed using the MineSight version 7.60 software package and comprised an array of 2 m x 2 m x 2 m sized blocks using a partial percentage attribute. The selection of the block size for this model was based upon the block size employed at the mine.

Gold grades were estimated into the blocks by means of ID^2, ID^3, OK, and NN interpolation algorithms. A total of four interpolation passes were carried out using distances derived from the variography results and the search ellipse parameters presented above. Pass #1 used search ellipses that were one-half of the variogram ranges, Pass #2 used search ellipses with the variogram ranges as defined, Pass #3 used twice the variogram ranges, and Pass #4 used four times the variogram ranges. The number of samples per quadrant was relaxed from two to one for passes #3 and #4, and the maximum number of composites per hole was relaxed from two to one for pass #4.

In general, “hard” domain boundaries were used along the contacts of each of the 16 individual mineralized domain models. Only data contained within the respective individual wireframe model were allowed to be used to estimate the grades of the blocks within the wireframe in question, and only those blocks within the wireframe limits were allowed to receive grade estimates.

CUT-OFF GRADE

The conceptual operational scenarios considered during preparation of previous Mineral Resource estimates envisioned that the fresh, unoxidized mineralization from the Pontal deposit would be excavated on a satellite deposit basis and transported by truck to the existing Turmalina plant for processing. Preliminary metallurgical tests have been completed on samples of fresh, unoxidized mineralization from the Pontal deposit from that conceptual perspective. They have yielded unacceptably low recoveries when the material is considered as potential feed to the existing Turmalina plant, and it has been concluded that the mineralization at the Pontal deposit is refractory. While the arsenical nature of the mineralization at Pontal is suspected to play a role in the poor recoveries, RPA believes that the testwork completed to date has not definitively supported this conclusion.

An alternative conceptual operational scenario was developed for the 2015 Mineral Resources in which the mineralized material will be excavated by means of underground mining methods and transported to the Turmalina plant for processing. A gold-rich flotation concentrate is envisioned to be generated after appropriate upgrades have been made to the existing plant. The gold-rich flotation concentrate would then be shipped or sold to a domestic source for recovery of the gold.

Input parameters to the estimate of an appropriate reporting cut-off grade considered this revised conceptual operating scenario along with the potential mining methods that are suitable for the mineralized wireframes at the Pontal deposit. Consideration was also given to the actual costs incurred at the Turmalina plant where appropriate.

A cut-off grade of 2.9 g/t Au is used for reporting of Mineral Resources. This cut-off grade was calculated using a gold price of US$1,400/oz, average gold recovery of 85% to flotation concentrate, 2014 actual cost data for the Turmalina Mine, along with estimated transportation and treatment charges. The gold prices used for resources are based on consensus, long term forecasts from banks, financial institutions, and other sources. RPA believes that the stated cut-off grade remains reasonable considering the relatively stable Mineral Resource cut-off grades at the Turmalina Mine between 2014 and 2018.

MINERAL RESOURCE ESTIMATE

The Mineral Resources are dominated by fresh, unoxidized material, but also contain a small proportion of oxide- and transition-hosted weathered material.

At a cut-off grade of 2.9 g/t Au, the Mineral Resources at the Pontal deposit total 410,000 tonnes at an average grade of 4.72 g/t Au containing 62,200 ounces of gold in the Measured and Indicated Resource category and 130,000 tonnes at an average grade of 5.0 g/t Au containing 21,000 ounces of gold in the Inferred Mineral Resource category (Table 14-19). RPA recommends that the Mineral Resource estimate for the Pontal deposit be re-evaluated if any material changes occur to the values of the cut-off grade input parameters.

No Mineral Reserves are present at the Pontal deposit.

TABLE 14-19 SUMMARY OF MINERAL RESOURCES AS OF DECEMBER 31, 2014 - PONTAL DEPOSIT
Jaguar Mining Inc. – Turmalina Mine Complex

Category	Tonnes (000)	Grade (g/t Au)	Contained Oz Au (000)
		Oxide	
Measured	30	4.13	4
Indicated	1	3.41	0
Sub-total M&I	**31**	**4.11**	**4**
Inferred	9	6.24	2
		Transition	
Measured	9	4.33	1
Indicated	2	3.34	0
Sub-total M&I	**11**	**4.17**	**1**
Inferred	2	7.28	1
		Fresh	
Measured	212	5.16	35
Indicated	157	4.29	22
Sub-total M&I	**369**	**4.79**	**57**
Inferred	119	4.89	19
		Total: Oxidized, Transition and Fresh	
Measured	251	5.00	40
Indicated	159	4.28	22
Sub-total M&I	**410**	**4.72**	**62**
Inferred	130	5.03	21

Notes:
1. CIM definitions were followed for Mineral Resources.
2. Mineral Resources are estimated at a cut-off grade of 2.9 g/t Au.
3. Mineral Resources are estimated using a long-term gold price of US$1,400 per ounce.
4. Mineral Resources are estimated using an average long-term foreign exchange rate of 2.5 Brazilian Reais: 1 US Dollar.
5. A minimum mining width of approximately two metres was used.
6. Bulk density is 1.46 t/m^3 or 1.52 t/m^3 for oxidized material, 2.24 t/m^3 or 2.28 t/m^3 for transition, and 2.73 t/m^3 for fresh, un-weathered material.
7. Gold grades are estimated by the inverse distance cubed interpolation algorithm.
8. No Mineral Reserves exist for the Pontal deposit.
9. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
10. Numbers may not add due to rounding.

15 MINERAL RESERVE ESTIMATE

SUMMARY

Table 15-1 summarizes the Mineral Reserves as of December 31, 2018 based on a US$1,300/oz gold price for the Turmalina Mine. Mineral Reserves are based on the Mineral Resources, mine designs, and external factors.

TABLE 15-1 MINERAL RESERVE ESTIMATE – DECEMBER 31, 2018
Jaguar Mining Inc. – Turmalina Mine Complex

Orebody	Proven Reserves			Probable Reserves			Proven and Probable Reserves		
	ROM (000 t)	Grade (g/t Au)	Oz Au (000)	ROM (000 t)	Grade (g/t Au)	Oz Au (000)	ROM (000 t)	Grade (g/t Au)	Oz Au (000)
Orebody ANW	116	6.40	24	192	6.60	40	308	6.52	64
Orebody ASE	229	4.64	34	65	3.36	7	294	4.36	41
Orebody CSE	388	3.53	44	418	5.85	79	806	4.73	123
Total	**733**	**4.33**	**102**	**675**	**5.82**	**126**	**1,408**	**5.05**	**228**

Notes:
1. CIM (2014) definitions were followed for Mineral Reserves.
2. Mineral Reserves were estimated at a break-even cut-off grade of 2.5 g/t Au, an incremental cut-off grade of 1.4 g/t Au.
3. Mineral Reserves are estimated using an average long-term gold price of US$1,300 per ounce, and an exchange rate of 3.70 Brazilian Reais: 1 US Dollar.
4. A minimum mining width of two metres was used.
5. Bulk density is 2.83 t/m^3 for Orebodies A and B and 2.91 t/m^3 for Orebody C at the Turmalina Mine.
6. Numbers may not add due to rounding.

The Mineral Reserves consist of selected portions of the Measured and Indicated Mineral Resources that are within designed stopes and associated development. The stope design was completed by MCB Serviços e Mineração (MCB). It is RPA's opinion that the Turmalina Mineral Reserve estimates comply with CIM (2014) definitions.

RPA is not aware of any mining, metallurgical, infrastructure, permitting, or other relevant factors that could material affect the Mineral Reserve estimate.

The Mineral Reserves are illustrated in Figure 15-1.

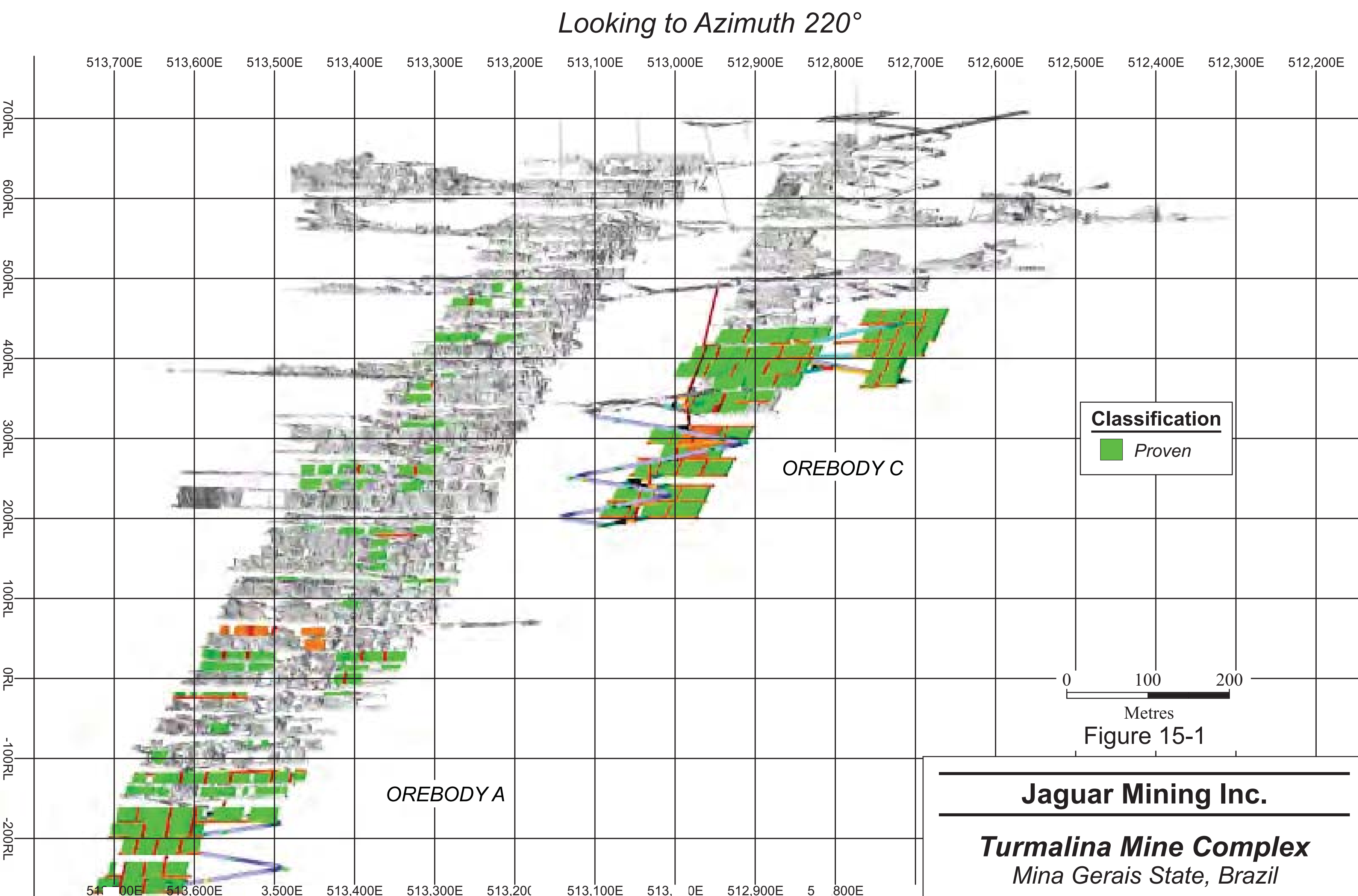


Figure 15-1

Jaguar Mining Inc.

Turmalina Mine Complex

Mina Gerais State, Brazil

Turmalina Mineral Reserves as of December 31, 2018

April 2019

Source: RPA, 2019.

DILUTION AND EXTRACTION

Dilution is addressed in two ways – internal to mine designs and external factoring. Internal, or planned, dilution is included in the design solids where they extend beyond the resource wireframe. Mining shapes are designed to be operationally achievable and respect minimum mining widths. As a result, internal dilution is included in the design solids. Additional volume included in this manner averages 15% across the Mineral Reserves.

External, or unplanned dilution accounts for overbreak during blasting, minor ground failures in open stopes, and backfill mucked up from the floor of stopes. It is addressed by applying percentage factors to various excavation types, as listed in Table 15-2: The factors are based on historical data from reconciliation.

TABLE 15-2 EXTERNAL DILUTION BY MINING METHOD
Jaguar Mining Inc. – Turmalina Mine Complex

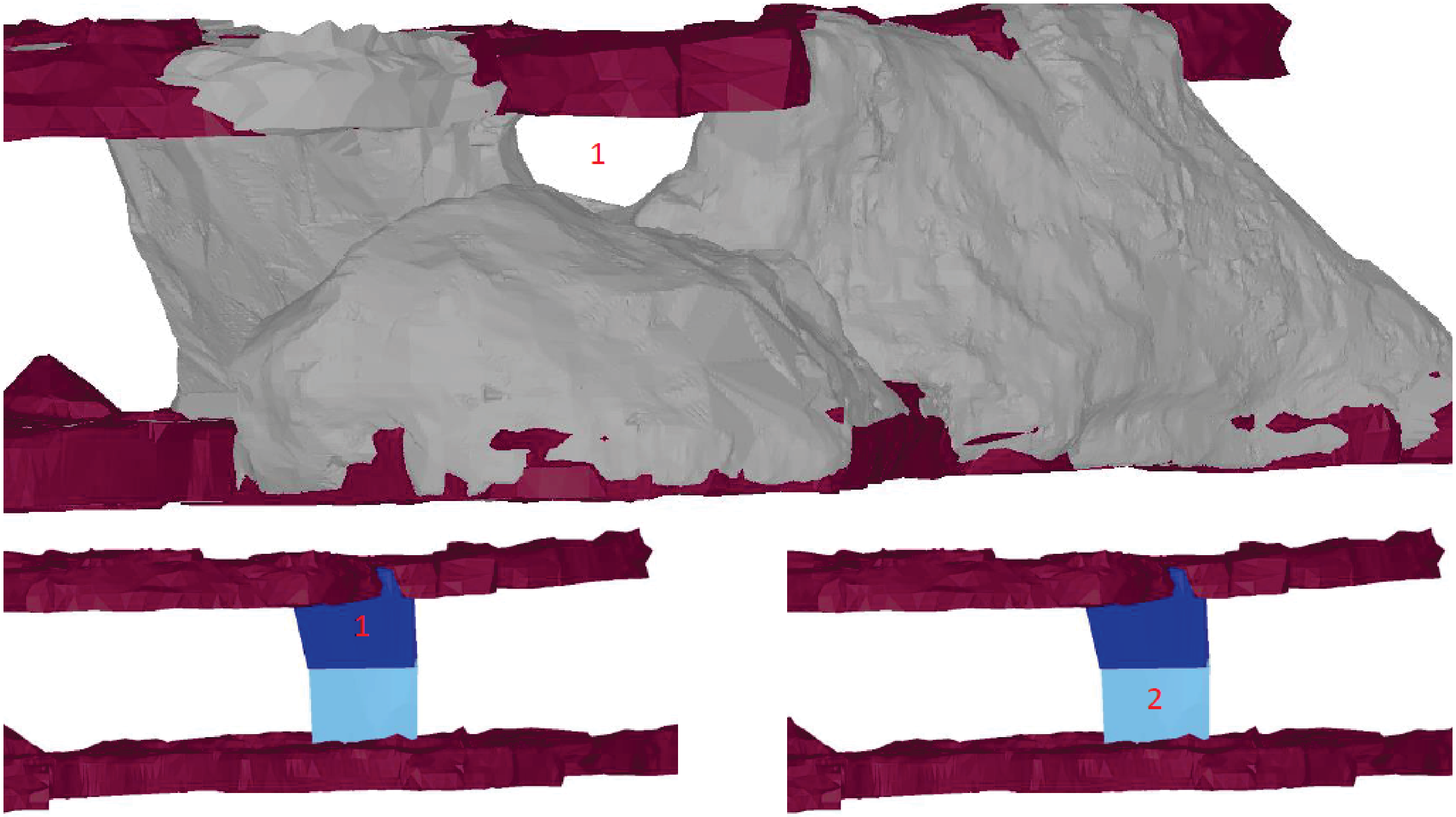
Mining Method	Dilution (%)
Raising	10
Development	20
Cut & Fill	8
Longhole Stoping	10

Total dilution included in reserves averages 25%, which is consistent with measured results for 2018 mining.

In order to reduce external dilution, stope pillars (1) are added in low grade areas as shown in Figure 15-2. A rib pillar is initially planned between the two stopes. Once the stope on the left is mined, the lower portion (2) of the rib pillar is recovered by drilling from the lower drill horizon. and then the next stope is mined.

In addition, stope drilling was previously carried out from the upper drill and lower drill drifts. This caused excess dilution where the two patterns intersected. The current operating practice is to only drill with down holes from the upper drill drift, except where the stope pillar is used.

Cable bolting of the hanging wall has also been implemented to reduce stope dilution.



1. Partial Rib Pillar: 2427 ton
Au (oz): 375

2. Rib Pillar (Recovery): 3470 ton
Au (oz): 481

Figure 15-2

Jaguar Mining Inc.

Turmalina Mine Complex
Mina Gerais State, Brazil

Typical Stope Pillar

April 2019

Source: RPA, 2019.

Extraction (mining recovery) is assumed to be 100%. Although some losses are encountered during blasting and mucking, they are minimal, and reconciliation (of mine production or Mineral Resource model) to mill results indicates that dilution and extraction assumptions match up well.

CUT-OFF GRADE

A break-even cut-off grade of 2.5 g/t Au was estimated for Mineral Reserves, using a gold price of US$1,300/oz, and average gold recovery of 90% and 2018 cost data for the Turmalina Mine. Gold prices used for Mineral Reserves are based on consensus, long term forecasts from banks, financial institutions, and other sources.

Cost data was converted to US dollars, using an exchange rate of 3.70 BRL to the US dollar. The majority of Turmalina costs are denominated in BRL. An operating cost of US$100 per tonne was used for the cut-off grade calculation.

TABLE 15-3 CUT OFF GRADE DATA
Jaguar Mining Inc. – Turmalina Mine Complex

Item	Value (US$)
Mining	59.06
Processing	33.23
G&A	3.30
Refinery	0.26
Exchange US/BRL	3.70

$$\text{Breakeven CoG} = \frac{\text{All fixed costs + All variable costs + Stay in Business Capital}}{\text{Gold price * 0.03215 * Gold Recovery}}$$

$$\text{Incremental CoG (extremity)} = \frac{\text{All variable costs}}{\text{Gold price * 0.03215 * Gold Recovery}}$$

An incremental cut-off grade of 1.40 g/t Au was estimated using variable costs only. Some stopes with diluted grades between 1.40 g/t Au and 2.50 g/t Au were included in Mineral Reserves. Incremental-grade stopes make up a small proportion of the total, which RPA considers to be reasonable. Although the cost data available from Turmalina is not easily categorized, unit mining costs vary between Orebody A and C, given significant differences between mining width, production rates, ground conditions, and haul distances. The mill has excess production capacity, not otherwise put to use. RPA recommends that Jaguar undertake a detailed incremental cost analysis, split by orebody, to ensure that uneconomic material is not sent to the mill.

16 MINING METHODS

The Turmalina Mine consists of a number of tabular zones grouped into three orebodies – Orebodies A, B, and C. Two satellite deposits, Faina and Pontal, are located along strike to the northwest. The mine produces 1,500 tpd from orebodies A and C.

The main production of the mine has been from Orebody A, which is folded, steeply east dipping, with a strike length of approximately 250 m to 300 m and an average thickness of six metres. Mineralization has been outlined to depths of 900 m below surface. The southern portion of Orebody A is composed of two parallel narrow veins. The northern portion of Orebody A is much the same as the southern portion, however, the two parallel zones nearly, or completely, merge and therefore the north zone is much wider overall (up to 10 m).

Orebody B includes three thinner, lower grade lenses parallel to Orebody A. Two of the lenses are located approximately 50 m to 75 m to the east in the hanging wall and are accessed by a series of cross-cuts that are driven from Orebody A. The mineralization in this deposit has been outlined along a strike length of approximately 350 m to 400 m and to depths of 900 m below surface. Orebody B is narrow along its entire strike length.

Orebody C is a series of 26 lenses that are located to the west in the structural footwall of Orebody A and are generally of lower grade. They strike northwest and dip steeply to the northeast. A minor amount of production has been achieved from these lenses to date. The mineralization in this deposit has been outlined along a strike length of approximately 800 m to 850 m and to depths of 700 m to 750 m below surface.

Figures 16-1 and 16-2 show mining in Orebodies A and C, respectively. No mining is currently carried out in Orebody B.

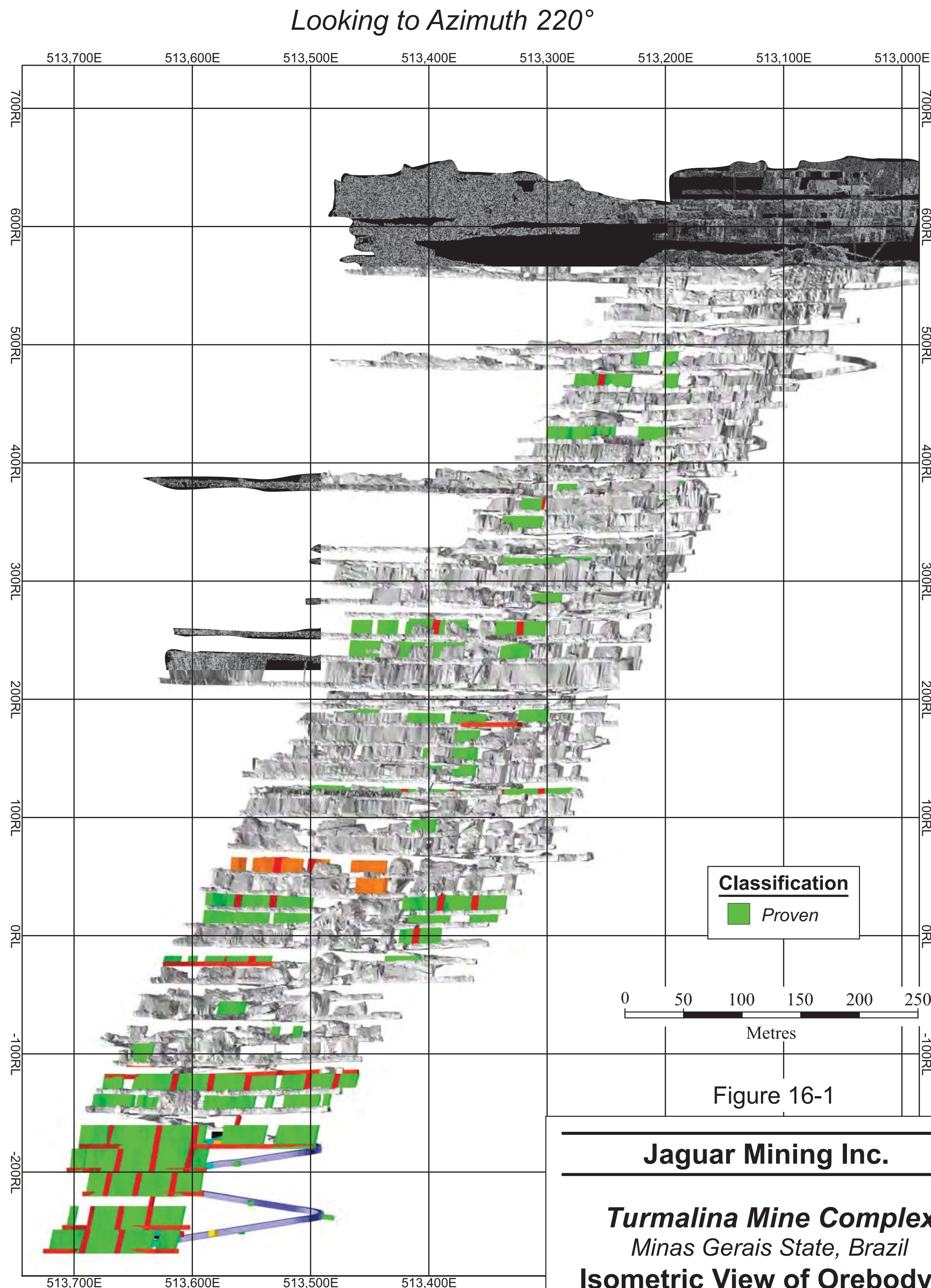


Figure 16-1

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Isometric View of Orebody A

April 2019

Source: RPA, 2019.

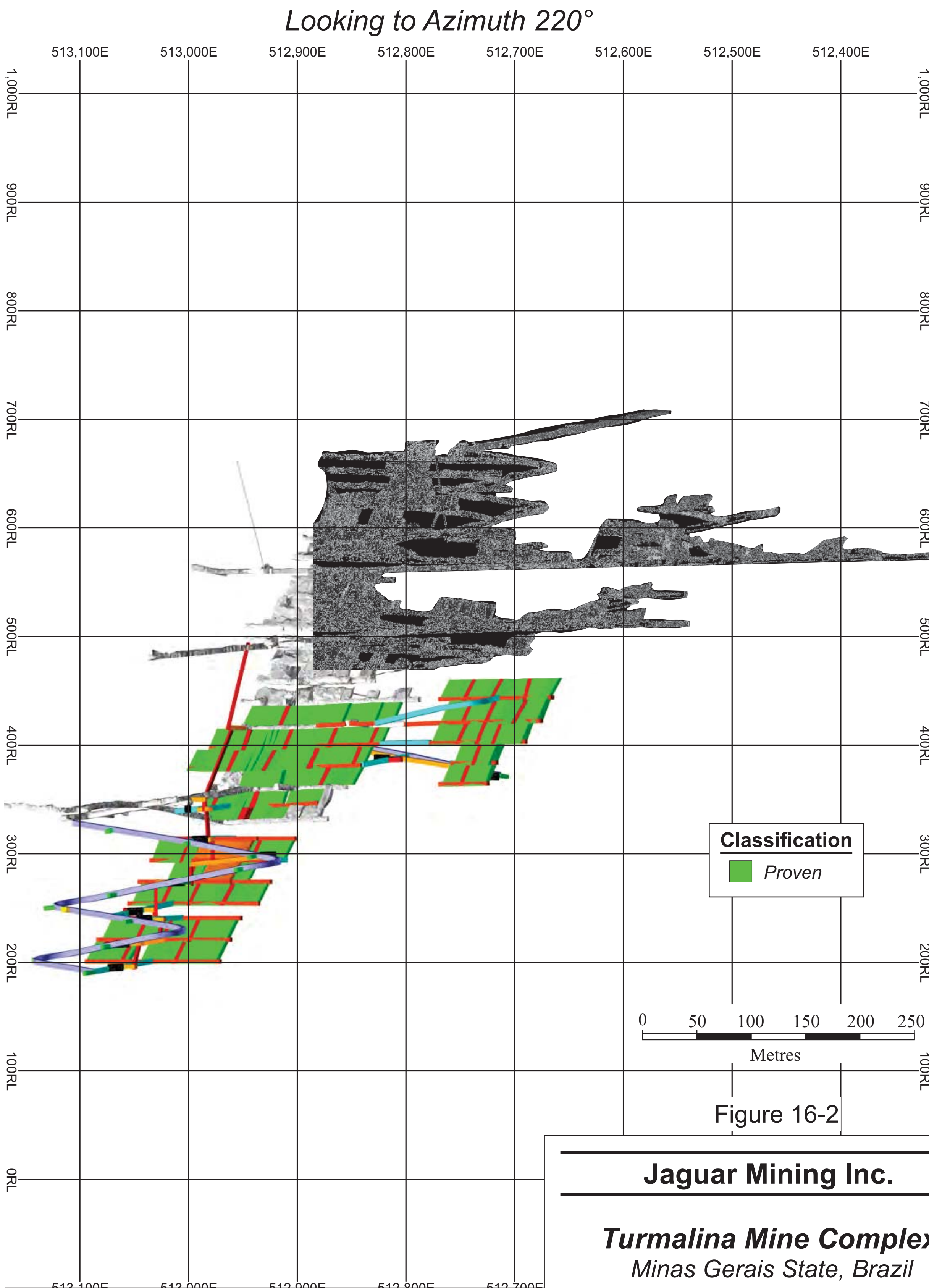


Figure 16-2

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Isometric View of Orebody C

April 2019

Source: RPA, 2019.

MINING METHOD

The mining method currently in use is longhole sublevel stoping with delayed backfill producing 1,500 tpd. Backfill consists of cemented rock fill, or a paste fill product prepared from detoxified CIP tailings in a plant located near the mill. Ore is hauled to surface using trucks via a ramping system for Orebodies A and C.

Ventilation for the mine is a pull system. Air is drawn down the main ramp and is exhausted via a vent raise adjacent to the ramps. The levels are ventilated using auxiliary ventilation fans and ducting.

Pumping water out of the mine is done using centrifugal pumps. The water is pumped level to level and then to surface.

The mine is accessed from a 5 m by 5 m primary decline located in the footwall of the deposit. The portal is located at an elevation of 695 m. The mine is divided into levels with Level 01 established at an elevation of 626 MASL. Starting at this level, the vertical clearance between levels is 114 m in the upper portions of the mine (i.e., Level 02 is at elevation 512 m). Five sublevels, spaced 20 m apart vertically, are driven from the main ramp. A three metre thick sill pillar was left below each main level, except for Level 3.

Since the initial development phases, level spacing has been modified so that the mining method could more easily adapt to changing conditions and modifications to the mining method. The current level spacing is 75 m with five sublevels spaced 15 m apart vertically, driven from the main ramp. A five metre thick sill pillar is left below each main level.

At each level and sublevel, drifts are developed in the mineralized zone to expose the hanging wall contacts. The drift is extended in both directions along strike, under geological control for alignment, continuing to expose the contacts until the limits of the orebody are reached.

Orebodies A and C are being mined, while mining in Orebody B has recently been halted. Orebody A is located in the footwall of the shear zone and Orebody B is located in the hanging wall of the shear structure.

Orebody A is closest to the main ramp and is accessed first. Development is currently progressing to Level 11 in Orebody A.

Orebody C is a secondary system being mined to the west of the portal. It is of lower grade than Orebody A. Orebody C is accessed from the main ramp at Level 02. A separate internal ramp was recently completed for Orebody C, which reduces the haul distance to the run-of-mine (ROM) ore stockpile, and reduces traffic on the main ramp.

Past mining used a longitudinal retreat sequence for Orebody A and Orebody B. Stope extraction began at the ends of the levels and retreated back towards the access. Stopes were 50 m in length along strike and separated by a five metre to ten metre wide pillar, depending on the thickness of the zone. Once mining of each longhole stope was completed, the excavation was filled using a combination of development waste and pumped paste fill. A bund was constructed using development waste to contain the backfill. Once the cement content of the paste fill was set, the next stope in the sequence was mined. The sequence continued until the entire level/sublevel was mined. Mining then proceeded upward to the next sublevel until the sill pillar was reached. Stopes were mined from several individual levels simultaneously in order to provide the required number of active workplaces needed to meet production targets.

The retreat sequence, and the need to complete Orebody B mining before cutting off access by mining Orebody A, reduced productivity by limiting the number of stopes available for mining at a given time. At this time, Orebody B is not part of the current LOMP. Currently there is still access to Orebody B via Orebody A.

The current LOMP does not consider mining of Orebody B, and involves a change in mine design. Orebody A is now being mined in a primary/secondary sequence via transverse access to the thick central portion of Orebody A, requiring additional accesses developed in waste. Each primary or secondary stope is 15 m along strike, with no pillars. The design change has the effect of increasing the number of available workplaces, and de-links the narrow, lower-productivity ends from the centre.

In RPA’s opinion, this innovation is critical to improving the mine’s ability to fill the mill to capacity with high grade ore.

Development waste is used for backfill, on an unconsolidated basis in secondary stopes, and with the addition of cement in primary stopes. Paste fill is used to tight fill the stopes immediately below the sill pillars, where consistent product is critical. The paste fill product is prepared from detoxified CIP tailings in a shear mixer and batch plant located near the mill.

Although mining of Orebody B is not in the LOMP and is no longer included in Mineral Reserves, future access is possible, either by mining through cemented paste fill and supporting appropriately, or by mining concurrently with the thinner ends of Orebody A.

GEOMECHANICS

Ground conditions were observed by RPA to be very good. The main decline, portions of which were developed up to ten years ago, did not exhibit any roof or wall deterioration. Primary support in the mine is provided by the use of Swellex, grouted rebar, and, in the wider areas, grouted cable bolts. In areas of friable ground, split-sets are used to hold welded-wire mesh in place.

In late 2017, there was a ground failure on Level 9, sublevel 0 of the mine that shut down the surrounding levels. The factors of the failure can be attributed to lack of timely placement of backfill. Jaguar hired full time ground control engineers to work at the mines. They have since modelled insitu and induced stresses using 2D and 3D software to determine effective stope and drift designs. Additional changes include more effective cable bolt designs for stopes and drifts, ground support QA/QC testing, and CMS surveys of stopes. The methodology for this analysis can be found in the report “Geotechnical properties of Turmalina Mine”, 2018, by Jaime A. Corredor H (Corredor H., 2018). RPA went underground and observed the methods being used, and has reviewed the Corredor report which is based on empirical ground control methods, rock mass classification methods, and cable bolt designs and agrees with the methods presented.

MINING EQUIPMENT

Development is completed using two-boom electric-hydraulic jumbos and six cubic yard load-haul-dump (LHD) units. In order to create adequate working space for the equipment, minimum widths of four metres must be maintained, causing significant dilution in areas where the orebodies are narrow. Two single-boom jumbos and an RDH Boltmaster with mesh-handling capability are used for the installation of ground support.

Drilling of the production holes is completed using a fleet of four Atlas Copco Simba longhole drills and cable bolting.

Development and stope mucking is completed using a fleet of seven 10 t to 14 t capacity LHD units (one ST14 and six ST1030 units), with development waste hauled to stopes or remuck areas, using two rented Atlas Copco MT431 haul trucks equipped with pusher plates.

Ore haulage to surface is by a fleet of seven Volvo 30 t off-highway surface trucks. An Atlas Copco MT42 truck is currently in use on a trial basis.

LIFE OF MINE PLAN

Stope and development designs, and production scheduling were carried out by MCB using Deswik mine design software, and modified by Jaguar to deplete for stopes mined out as of December 31, 2018.

The production schedule is summarized in Table 16-1 and covers a mine life of four years based on Mineral Reserves.

TABLE 16-1 LOMP PRODUCTION SCHEDULE
Jaguar Mining Inc. – Turmalina Mine Complex

Item	Units	2019	2020	2021	2022	Total
Total Mill Feed	Tonnes (000)	376	326	402	305	**1,408**
	g/t Au	4.95	5.78	4.69	4.84	**5.05**
Recovery	%	91.0%	91.0%	91.0%	91.0%	**91.0%**
Gold Produced	Ounces (000)	**55**	**55**	**55**	**43**	**208**

Scheduling is based on productivities achieved in recent operations. Development is limited to 60 m per month on the main ramp and 30 m per month on any single heading elsewhere.

Stope scheduling follows the primary/secondary sequence where transverse mining is applied, otherwise it is based on retreat mining and includes delays for backfilling and cement curing.

17 RECOVERY METHODS

The plant has a nominal processing capacity of 2,000 dmt per day, or 720,000 dmt per year. Since inception, the plant has been achieving annual overall recoveries of between 87% and 92%. The process flowsheet includes two-stage crushing and screening to minus 9.5 mm (-3/8 inches), primary grinding, thickening, cyanide leaching, CIP, elution, electrowinning, and smelting. The tailings are conveyed to a detoxification unit for arsenic removal and cyanide destruction and then are pumped to the paste fill plant to be used either for mine backfill or deposited on a purpose-built dry-stack storage area. Process tailings have also been stored in completed open pits on the mine site (Figure 17-1).

A process control system has been established at the supervisory level via a conventional programmable logic controller (PLC) system. It is based on a process control philosophy that is compatible to harbor an online optimizing system (Advanced Control System, or ACS) in the future. The ACS entails both Expert and AI-based levels, the highest objective function being throughput. PIMS, LIMS, and MES Corporate Systems are also envisioned to be implemented when appropriate. The control room is located close to the hydrometallurgical plant. Three dedicated PLCs control the crushing and screening plant, the thickener, grinding plant, hydrometallurgical plant, the paste fill plant, and the Detox plant.

The current flowsheet is shown in Figure 17-2 and is described below. A summary of the mill production history and recovery has been presented in Table 6-1 in Section 6 of this report.

CRUSHING AND SCREENING

Ore produced at the Turmalina Mine is transported to the adjacent CIL processing plant.

ROM material is stored in a surge pile and fed to the primary jaw crusher using a front end loader at a nominal rate of 140 tonnes per hour (tph). The crushing plant has a design capacity of 180 tph. Oversized material is managed with a grizzly and rock breaker. The primary crusher product is fed to secondary cone crushers. The final product, minus 9.5 mm (-3/8 inches), is stored in a grinding plant surge bin.

GRINDING, CLASSIFICATION AND THICKENING

The Turmalina plant consists of three ball mills, of which two have been operating since January 2016 (Mills #1 and #2) at a capacity of 1,500 tpd to 1,600 tpd.

The feed grade to the grinding mills is determined by sampling with an automatic sampler. Material is fed from the surge bin to the grinding circuit that consists of ball mills of three different sizes set up in parallel, although only two mills are currently operating on a continual basis. The first ball mill is 3.2 m x 4.7 m (10.5 ft x 15.5 ft) in size with a maximum capacity of 25 tph and is operated by a 745 kW (1,000 HP) motor. The second mill is 3.8 m x 5.5 m (12.5 ft x 18 ft) in size with a maximum capacity of 60 tph and is operated with a 1,342 kW (1,800 HP) motor. The third mill is 4 m x 6.6 m (13 ft x 21.8 ft) in size with a maximum capacity of 70 tph and is operated by a 1,491 kW (2,000 HP) motor. Lead nitrate [$Pb(NO_3)_2$] is added at a rate of 50 g/t in the grinding feeds in order to avoid excessive NaCN consumption by the formation of thiocyanides (SCN), ferrocyanides $(Fe(CN)_6)^{4-}$, and ferricyanides $(Fe(CN)_6)^{3-}$.

The milling products are sized with cyclones to 80% passing 200 mesh (P_{80} = 200 mesh), with the overflow passing on to the thickener and the underflow recycled. The grinding circuit is automated.

The secondary cyclone overflow stream is fed to a 30.5m (100 ft) thickener where flocculants are added to optimize the settling cycle of the pulp. The thickener underflow, 53% solids by weight, is pumped to the pulp conditioning system of the CIP plant, which is instrumented to maintain the pulp at a density of approximately 48% to 50%, by weight, solids. The water addition flow rate is monitored and controlled by a magnetic flow meter and pulp densitometer. The thickener overflow is directed to the process water tank as make-up water.

In January 2017, Mill #3 was recommissioned with an estimated installed capacity of 1,600 tpd. Using only Mill #3, Turmalina will be able to achieve the entire throughput of the plant with a lower operating cost, through electricity consumption savings, compared to using both Mills #1 and #2 in 2016. As a result, Mills #1 and #2 have been taken off-line for maintenance and will be kept on standby mode in the future. The addition of Mill #3 allows the processing plant to be run at a full capacity of 2,000 tpd, or approximately 720,000 tpa, in future years using a combination of mills.

During 2018, the plant processed approximately 322,000 tonnes at an average grade of 3.44 g/t Au compared to 427,000 tonnes at 3.48 g/t Au in 2017. Overall, the processing plant recovery was 90.7% in 2018, which is slightly lower than the 91% recovery rate for 2017.

LEACHING CIRCUIT

The leaching circuit consists of seven agitation tanks. Lime is added to the first tank to adjust the pH. Cyanidation begins in the first tank with the addition of sodium cyanide (NaCN). Lead nitrate is also added in the grinding circuit to control excessive NaCN consumption. Compressed air is injected in the bottom of all the tanks at a rate of 2,000 cfm and at a pressure of 3.5 kg/cm^2, as the process consumes large amounts of oxygen. The residence time in the leaching circuit is approximately 25 hrs.

ADSORPTION CIRCUIT

The adsorption circuit is a conventional CIP circuit. The gold-bearing pulp passes through five adsorption tanks arranged in series. Activated carbon with a size range of 8 mesh to 16 mesh and a minimum pulp concentration of 20 g/L is added to the last in the series of tanks, and is pumped in the opposite direction from the sludge flow. Thus, the carbon adsorbs the gold from the pulp as the process continues. When the adsorption cycle is completed, approximately ten hours, the loaded carbon, containing approximately 1.5 kg of gold per tonne of carbon, is pumped from the bottom of the first tank in the series to the elution and electrowinning circuit.

ELUTION AND ELECTROWINNING

The loaded carbon is screened and the minus 28 mesh material is redirected back to the adsorption circuit. The oversize feeds the elution circuit, comprising four columns, two of which are stripping while the other two are loading. The estimated carbon load in each column (1.25 m in diameter and 6.25 m high) is approximately 2.7 t. Loaded carbon is stripped using caustic soda, injected into the elution columns from bottom to top at a concentration of 1% by weight with 200 L of ethylic alcohol (per batch) kept at 95°C. The pregnant solution is stored in a tank, with overflow to feed the electrowinning circuit. The electrowinning circuit consists of six cathodes and seven anodes, energized with a 360 A current and a voltage of 3.5 V to 4.0 V.

Up to 2012, Jaguar was shipping the steel wool and sludge to the refinery. Since 2012, it has shipped the cake resulting from alcoholic carbon elution of the steel wool.

ACID WASHING

The activated carbon first undergoes a stripping process in the elution columns, where the adsorbed gold is removed by a 1% (by weight) NaOH alcoholic solution at 95°C. It is then conveyed to a surge tank via an ejector directed towards a 28 mesh screen for the removal of fines (undersize). The screen oversize is conveyed to a 8 m^3 fibreglass acid washing tank. Acid washing is necessary to maintain the loading capacity of the activated carbon since the mineral matrix possesses other cations such as calcium, iron, copper, zinc, and lead that compete with gold in the interstices of the activated carbon. The acid washing is completely effected by passing an acid solution of HCl at 10%, removing the impurities that diminish the capacity of the carbon to adsorb gold, mainly carbonates and basic metals.

The acid solution of HCl at 10% (by weight) is prepared in a fibreglass HCl solution tank by adding water and HCl at 33% by weight. This solution is injected at the bottom and discharged at the top of the acid washing tank by overflow, returning to the HCl solution tank by gravity. The time involved in the acid washing is approximately 16 hours.

Once acid washing is completed, the acid solution is drained towards a neutralization tank. The carbon will be neutralized with a 1% (by weight) NaOH solution using a procedure identical to the one used for the acid solution. The neutralization time ranges from one to two hours, depending on the pH control of the recycled solution. The remaining solution is also drained to the neutralization pond. Thereafter, the carbon is washed with water in open circuit with regard to the neutralization pond. This operation lasts approximately two hours. After these stages, the carbon is transferred to the 28 mesh screen and can be conveyed to the carbon addition circuit in the volumetric control vessel, and then to the last adsorption tank in the CIP circuit.

DETOXIFICATION PLANT

The adsorption tank tailings (86 tph at 42% solids) are conveyed by gravity to a belt screen in order to avoid carbon loss and then to a tailings pulp treatment plant (TPTP or Detox plant) and then to the paste fill plant. This material is used as backfill in the mine for structural purposes, when required. In some cases, its addition to a mechanical waste fill is required.

PASTE FILL PLANT

The treated tailings from the Detox plant, a pulp at 42% solids by weight, are conveyed to a pumping station where they are sent by rubber lined centrifugal pumps (75 HP – one operating and one standby) to the paste fill plant, which is located about one kilometre away from the pumping station. The slurry is received in a pulp storage tank, from which it is pumped to a hydrocyclone cluster, and the overflow feeds a thickener. The cyclone underflow, together with thickener underflow, feeds three drum filters (3.0 m x 4.9 m, 10 ft x 16 ft). The filtration process generates a cake and a filtrate (liquid phase). The thickener overflow is recycled to the industrial water tank, while the filtrate (up to 8% ultra-fines solids) is conveyed to the tailings dam.

The cake from the filters, after having gone through the stages of the filtration cycle (cake formation, washing, drying, blow, and discharge), contains approximately 30% moisture. It is conveyed through a 914.4 mm (36 in). wide, 27 m long conveyor belt to the cake preconditioning hopper, after which the cake is sent to the weigh hopper where additives such as Portland cement or, alternatively, “Fosbinder” are added in proportion to the cake mass flow. Other binders aimed to impart structural properties to the paste, as well as to neutralize excess acidity due to its high carbonate content, can also be added. The cake is then directed to the paste mixer for the final paste production. The paste will be used as fill in the underground mine.

During periods when paste fill is not needed for structural purposes in the mine, the tailings bypass the paste fill plant and are directed to the tailings dam, along with the filtrate (8% ultra-fine solids).

Paste fill plant rebuilding is complete and the plant was fully operational in 2018. The paste fill plant was changed from a continuous process to a batch process, which will allow better control on the paste characteristics for backfill. Paste fill has been used at the mine recently – rockfill and cemented rockfill have been used in backfilling Orebody A while filtered tailings have been used to backfill Orebody C as well as paste fill.

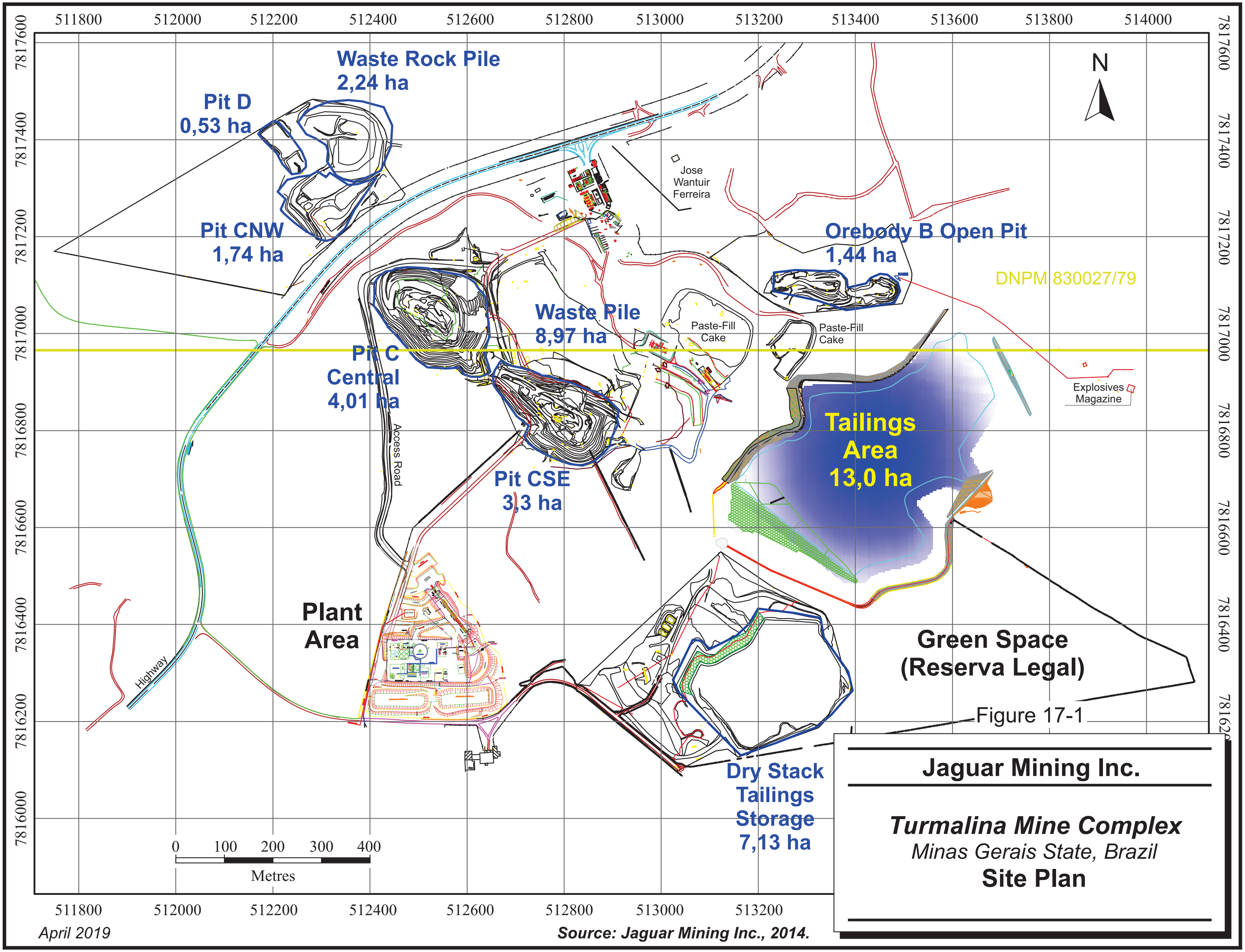


Figure 17-1

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Site Plan

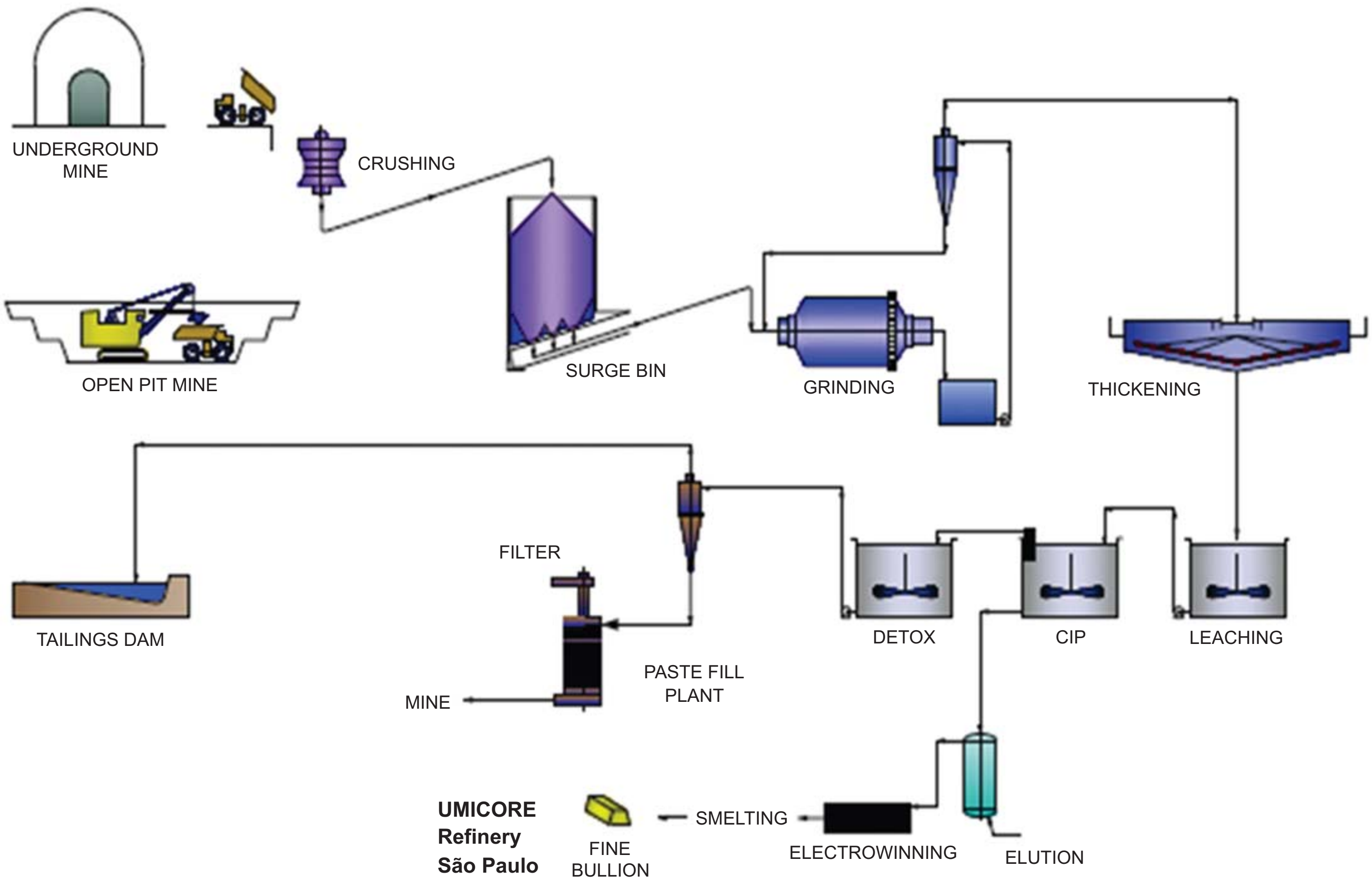


Figure 17-2

Jaguar Mining Inc.

Turmalina Mine Complex

Minas Gerais State, Brazil

Process Flowsheet

April 2019

Source: Jaguar Mining Inc., 2014.

18 PROJECT INFRASTRUCTURE

The Turmalina Mine Complex includes a nominal 2,000 tpd processing plant and tailings disposal area. Electrical power is obtained from the national grid.

All ancillary buildings are located near the mine entrance: gate house including a reception area and waiting room, administration building, maintenance shops, cafeteria, warehouse, change room, first aid, and compressor room. The explosives warehouse is located 1.2 km away from the mine area, in compliance with the regulations set forth by the Brazilian Army. There is no camp at the mine site.

Other ancillary buildings are located near the processing plant and include an office building, a laboratory, warehousing, and a small maintenance shop.

There is no infrastructure related to the Faina and Pontal historic open pit operations.

19 MARKET STUDIES AND CONTRACTS

MARKETS

Gold is the principal commodity at the Turmalina Mine Complex and is freely traded, at prices that are widely known, so that prospects for sale of any production are virtually assured. A gold price of $1,300 per ounce was used for estimation of Mineral Reserves.

CONTRACTS

RPA reviewed recent costs for transportation, security, insurance, and sales of doré, and considers them to be within industry norms.

20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

ENVIRONMENTAL STUDIES

Environmental studies related to the acid mine drainage potential have been carried out as requested by SUPRAM, the state environmental agency, on Operation Licence (‘Licença de Operação’, or LO) 012/2008. These studies continued from 2007 through 2017. In February 2018, a specialized report was issued. It indicated the low potential to generate acid mine drainage due to the low concentration of sulphides and the presence of compounds with neutralization potential, such as carbonates. However, the study also indicated the arsenic leaching potential and, as a result, the company initiated leaching monitoring. The company has officially informed the agency about the arsenic leaching potential.

PROJECT PERMITTING

ORIGINAL TURMALINA PROJECT LICENCES

In 2005, Jaguar applied for a Preliminary Licence (‘Licença Prévia’, or LP) related to the original Turmalina Gold Project, for both the open pit and underground exploitation of the sulphide mineralized body on Mining Concession ANM 812.003/75 and the mineral processing plant. LP 078/2005 was granted to Jaguar in October 2005. Along with the LP application, an environmental study was submitted which formed an Environmental Control Report (‘Relatório de Controle Ambiental’, or RCA). In November 2005, Jaguar applied for an Installation Licence (‘Licença de Instalação’, or LI) for the Turmalina Gold Project. In August 2006, COPAM, the State Environmental Policy Council, granted Jaguar the LI (LI 114/2006) upon review of the Environmental Control Plan (‘Plano de Controle Ambiental, or PCA). An Operating Licence (‘Licença de Operação’, or LO) for the Turmalina Gold Project was applied for in February 2007 and was granted in June 2008 (LO 012/2008).

Jaguar applied for the revalidation of the LO in March 2012, renovating all the operations at the project, including the tailings disposal system, underground open pit operations, the plant, and mine, which are currently under review by COPAM under process 01154/2005/012/2012. In August 2018, Jaguar submitted an additional information report as requested by COPAM. A list of the existing permits is presented in Tables 20-1 and 20-2.

TABLE 20-1 LIST OF EXISTING OPERATING LICENCES
Jaguar Mining Inc. – Turmalina Mine Complex

Enterprise	Certificate Number	Process Number (PA COPAM)	ANM	Granting Date	Expiration Date	Observation
Plant, waste pile, open pit and underground mine	LO 012/2008	01154/2005/003/2007	930.086/2005	19/06/2008	19/06/2012	This licence is in revalidation process since 2012 (PA COPAM 01154/2005/012/2012).
Tailings dam	LO 012/2009	01154/2005/008/2009	930.086/2005	17/12/2009	17/12/2013	This licence is in revalidation process since 2012 (PA COPAM 01154/2005/012/2012).
Expansion Project – plant, waste pile, open pit and underground mine	LOC 076/2009	01154/2005/007/2009	930.086/2005	17/12/2009	17/12/2013	The LOC 076/2009 improved the first licence (LO 012/2008). This licence is in revalidation process since 2012 (PA COPAM 01154/2005/012/2012).

Note 1: Application to renew these permits has been submitted; renewal approvals are pending. Some complementary information was requested by SUPRAM and has been supplied by environmental team. According to the law (Deliberação Normativa COPAM 17/1996) the licences remain valid.

TABLE 20-2 LIST OF WATER USE LICENCES
Jaguar Mining Inc. – Turmalina Mine Complex

Ordinance	Grant Date	Expiration Date	Procedure Number	Watercourse	Permitted Rates	Status
00716/2011	05/04/2011	17/03/2017	12594/2010	Pará river	Surface water – 28.3 L/s	In revalidation process
00579/2010	10/03/2009	09/03/2014	07142/2008	Dam	24 L/s	In revalidation process
03404/2012	26/11/2012	23/11/2017	03962/2010	Lowering water Level for Mining	470.9 m³/h	In revalidation process
01129/2009	15/05/2009	12/05/2014	03924/2006	Water well	4.6 m³/h	In revalidation process
02783/2009	20/10/2009	20/10/2013	01170/2008	Water well	6.77 m³/h	In revalidation process

EXPANSION PROJECT LICENCES

Minas Gerais State Decree 44.844/2008 of June 25, 2008, states that given the operating situation and production status at the Turmalina Mine, Jaguar was allowed to apply directly for an LO for the Expansion Project, which was granted in December 2009 (LO-C 076/2009). To be able to start the development works at the Expansion Project, Jaguar applied for an Environmental Authorization for Operation (AAF), as reported below.

In April 2008, Jaguar applied for two AAFs, one for underground and the other for open pit operations in Orebody C, located on ANM 803.470/1978. The AAF for the underground operations was granted by SUPRAM in September 2008 (AAF 04524/2008) and the AAF for the open pit was granted in January 2009 (AAF 00001/2009).

For the open pit operations at Faina, located on ANM 812.003/1975, an AAF was applied for in September 2009 and granted by SUPRAM in June 2010 (AAF 01822/2010).

The AAFs for an open pit mine allow for the mining of 50,000 tpa at each of Orebody C and Faina, while the AAF for an underground mine permits mining of 100,000 tpa.

In November 2009, an LP+LI for the Expansion Project was applied for, and granted in February 2011 (LP+LI 001/2011).

TURMALINA AND TURMALINA EXPANSION TAILINGS DISPOSAL SYSTEM LICENCES

Jaguar applied for an LI for the tailings disposal system in November 2007, along with the Environmental Impact Assessment/Report of Impacts on the Environment (EIA/RIMA) and the PCA. The tailings disposal system is a downstream construction and is currently being used as a water dam. Turmalina tailings are filtered and dry stacked or used as underground paste fill. All dams are inspected twice a month by an external geotechnical consultant. This is an operating inspection. There are semi-annual geotechnical stability inspections done by an external geotechnical consultant. The stability consultant is Instituto Brasil. The application and pertinent documents were reviewed by SUPRAM, and LI 005/2009 was granted in August 2009.

In regard to the tailings disposal system operations, the LO was applied for in September 2009 and granted in December 2009 (LO 012/2009).

The upper portion of the central Orebody C was mined using the open pit method, which is now completed. Part of the mine surface area does not belong to Jaguar. The benches were designed to have a slight incline (1.0%) from slope crest to toe to allow drainage of storm and ground water. Benches between elevations 750 m and 720 m also had an incline of 1% to their toes at the natural ground level. Below elevation 720 m, sumps were constructed to collect all ground and storm water, which was then pumped to the mine's water treatment system.

Orebody C is currently being mined using sublevel stoping. Underground mining of Orebody C was fully integrated with the remainder of Turmalina's underground mining operations, including the opening of a ramp and access drifts to the bodies from the main decline. After being mined, panels are filled with paste fill from the current Turmalina paste backfill plant. This underground method is considered to be favourable from an environmental impact perspective, since placing paste backfill in the stope panels reduces the requirement for surface tailings storage.

A new waste stockpile has been designed for waste rock storage adjacent to the existing Turmalina waste stockpile. It has the same configuration as the existing stockpile, with a bench height of 10 m, bench width of 5 m, slope face angle of 30°, and overall stockpile angle of 26°.

The tailings system is a single downstream step with a full capacity of 790,682 m^3. Less than three percent of the tailings is sent to the dam. The tailings are filtered and dry stacked, and used for paste fill. The detailed engineering project was completed by the local consulting company Engeo Ltda (ENGEO).

All tailings disposed of in the dam are first detoxified in a Caro's acid detoxification plant (CyPlus technology – "cold"), as described below. The detoxification plant was constructed by EVONIK in Mobile, Alabama, USA. The process was conceived by CyPlus, a Degussa technology company that specializes in the application of peroxide, SO_2, and/or Caro's acid to detoxify cyanide residue and arsenic from the tailings of gold processing plants. The selected treatment uses Caro's acid as a reagent to promote the decomposition of cyanide to cyanate and to reduce the concentration of arsenic in the tailings that will be used in the production of the paste fill.

In order to generate Caro's acid, concentrated sulphuric acid is mixed with 50% oxygenized water in a Teflon/stainless steel reactor. Caro's acid promotes the oxidation of cyanide to cyanate, and cyanate is considered to be 1,000 times less toxic than cyanide. The cyanate then decomposes into carbon dioxide and ammonia by hydrolysis.

Caro's acid acts with efficiency to eliminate arsenic while in solution, causing the oxidation of As(III) to As(IV), and As(IV) is easily precipitated with ions from iron, calcium, and magnesium. Under these conditions, the used metal becomes immobilized in the paste fill, neither interacting with the environment nor undergoing any type of leaching being dissolved by the underground water or by rainfall (if the paste is not contained and piled outside).

After the detoxification process, the pulp is sent to two 0.25 m (10 in.) cyclones, where it is either thickened to make paste fill or, if there is no current need for paste, sent to the tailings disposal system.

When required for use as backfill, the cyclone underflow from the plant, with 70% solids, is used in the production of the paste fill and then returned to the mine as fill to the mining stopes. The overflow, with fine solid particles and the majority of the water, is thickened and also used in the production of the paste fill. In the event of a temporary malfunction of the above process, the referred material is sent to the emergency chambers or to the tailings disposal system.

The detoxified solution, separated from the tailings, is then recirculated for use in the processing plant, thus closing the circuit for the process water.

TABLE 20-3 TURMALINA TAILINGS DAM CONTROL PROCESS
Jaguar Mining Inc. – Turmalina Mine Complex

Technical Sheet	
Height of the Dam (m)	17
Full Capacity (m^3)	790,682.70
Total Length of the Crest (m)	198
DPA (associated potential damage)	High
CRI (category of risk)	Low
Class by Law nº 70.389/2017	B
Class by Law DN nº 62/2002	III
Waste Class	Class I
Construction Method	Single downstream step
Spillway System	Yes
Emergency Action Plan (PAEBM)	Yes
Construction Year	2009
Sealing Dam	Yes

The Turmalina dam has control processes in place, through periodic inspections carried out twice a month and reports of stability condition, in addition to a monitoring network that allows the company to be constantly alert about its structures.

Jaguar has been following all the recent changes in the laws and complies with all regulations.

SOCIAL OR COMMUNITY REQUIREMENTS

The Turmalina operations are located close to the border of the municipality of Conceição do Pará in the central western part of the state of Minas Gerais, near the small town of Casquilho.

Casquilho's community is a district of Conceição do Pará and is in the area that is directly impacted by the operations. Being too small, this town does not offer quality infrastructure services sourcing them from a nearby larger town, Pitangui, located 15 km from Conceição do Pará.

State road MG 423 divides Casquilho's community into Casquilho de Baixo (lower Casquilho) and Casquilho de Cima (upper Casquilho), with a total population of 130 families. The majority of the Casquilho de Cima houses is permanently occupied and most residents work in Pitangui. Only five houses are used as weekend properties.

Casquilho de Cima's community is supplied with water and power by the state-run companies Copasa and CEMIG. The community does not have any sanitation sewage system. Old fashioned farm-like sanitation holes/ditches, typically built in the backyards, are used. No additional public service is available to the Casquilho de Cima residents.

Since the beginning of the Turmalina Mine operation, dust suppression has been carried out by Jaguar at the mine and plant access roads.

Jaguar has good community relationships with the surrounding communities.

MINE CLOSURE REQUIREMENTS

Two years before the mine is exhausted, Jaguar must submit the Mining Closure Plan ('Plano de Fechamento de Mina', or PAFEM) to SUPRAM for approval, according to the "Deliberação Normativa COPAM nº 127". This regulation also enforces that all mining activities in the state of Minas Gerais include the rehabilitation plan of disturbed areas.

The actions and steps for the environmental recovery of the areas impacted by mining activity were adopted when the LI was granted and will continue until after the mine is exhausted.

The recovery of the surface areas will follow the following steps:

- Removal and stockpiling of the fertile soil layer;
- Waste and backfill paste disposal;
- Rehabilitation of the mined areas;
- Topographical regularization;
- Re-vegetation of the impacted areas, mainly those resulting from open pit mining;
- Rehabilitation of drainage ditches, contention sumps, contention dykes, etc.;

The following actions will be required with regard to the underground mine:

- Gradual refill of the exhausted panels.
- Obstruction of the initial 50 m of the ramp with waste, to be stocked near the mine entrance in advance.
- Construction of a cut at the mine entrance at an inclination of 35º to fill the opening created during the mine entrance development with the removed material. It will be completely filled, and the cut and fill re-vegetated.
- Obstruction of the entrances to the ventilation and emergency raises with a 10 m deep reinforced concrete wall. This will be done with waste material, to be stocked for this purpose in advance. The related surface areas will be re-vegetated.

As of December 31, 2018, Jaguar estimated rehabilitation and reclamation costs to be US$5.1 million, on an undiscounted, uninflated basis as shown in Table 20-4.

TABLE 20-4 PROGRESSIVE REHABILITATION AND CLOSURE COST ESTIMATES
Jaguar Mining Inc. – Turmalina Mine Complex

Description	Units	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Total
Waste Pile	US$ (000)	35	35	35	14	118	100	489	237	67	21	8	**1,156**
Pit	US$ (000)	76	15	7	7	40	31	21	9	-	-	6	**212**
Dam	US$ (000)	-			19	12	9	325	325	33	26	11	**762**
Infrastructure	US$ (000)	-	39	6	18	13		276	223	38	21	10	**643**
Plant	US$ (000)	-	-	-	13		9	233	525	27	15	9	**831**
G&A	US$ (000)	41	23	34	9	48	40	118	112	43	51	89	**609**
Contingency	US$ (000)	31	23	18	12	47	39	299	293	43	28	27	**860**
Total	US$ (000)	**182**	**135**	**100**	**92**	**278**	**228**	**1,758**	**1,725**	**251**	**162**	**161**	**5,073**

*Note: Numbers may not add due to rounding. No inflation or discount factors applied.

21 CAPITAL AND OPERATING COSTS

Costs for the LOMP were estimated in BRL, based on recent operating results and Jaguar budgets.

Strengthening of the US dollar against the BRL over the past few years has had a significant impact in reducing US$ unit costs. Jaguar used an exchange rate of US$1.00 = 3.70 BRL for 2019.

CAPITAL COSTS

A summary of capital, exploration, and closure requirements anticipated over the LOMP is summarized in Table 21-1.

TABLE 21-1 LOMP CAPITAL COST SUMMARY
Jaguar Mining Inc. –Turmalina Mine Complex

	Units	Total	2019	2020	2021	2022
Direct Cost						
Mining	US$ (000)	**9,324**	4,865	4,459	-	-
Processing	US$ (000)	**-**	-	-	-	-
Infrastructure	US$ (000)	**-**	-	-	-	-
Exploration	US$ (000)	**7,357**	1,839	1,839	1,839	1,839
Total Direct Cost	US$ (000)	**16,681**	6,704	6,299	1,839	1,839
Sustaining						
Sustaining	US$ (000)	**15,572**	8,021	2,617	2,467	2,467
Reclamation and Closure	US$ (000)	**5,073**	184	135	100	4,495
Total Capital Cost	**US$ (000)**	**54,007**	**21,613**	**15,349**	**6,245**	**10,640**

Sustaining capital costs are estimated to be $15.6 million, of which $0.8 million is spent on rebuilds. Primary development consists of approximately 150 m of horizontal development over the LOMP. The capital development is well advanced at the mine, hence the low amount of development.

Exploration drilling will continue, with an aim to extend and define resources at depth.

Reclamation and closure costs are as described in Section 20.

OPERATING COSTS

Operating costs for the LOMP are shown below in Table 21-2. Operating cost estimates include mining and processing, and general and administration (G&A). Operating costs are budget cost projections based on actual costs incurred over the past year.

TABLE 21-2 LOM OPERATING COST SUMMARY
Jaguar Mining Inc. – Turmalina Mine Complex

Unit Costs	Unit	Average	2019	2020	2021	2022
Mining (Underground)	US$/t milled	**43.15**	52.67	46.17	37.91	35.11
Processing	US$/t milled	**26.41**	33.49	33.49	33.49	33.49
G&A	US$/t milled	**8.39**	8.23	9.61	7.80	8.06
Total Unit Operating Cost	**US$/t milled**	**85.03**	**94.39**	**89.28**	**79.19**	**77.66**

There are additional corporate overhead costs associated with the Belo Horizonte and Toronto offices, as well as royalties and refining costs, which are not included in the operating cost estimate.

All-In Sustaining cost (as defined by the World Gold Council) for the Turmalina Mine is $1,048/oz, including reclamation and closure.

22 ECONOMIC ANALYSIS

This section is not required as the property is currently in production, Jaguar is a producing issuer, and there is no material expansion of current production. RPA has verified the economic viability of the Mineral Reserves via cash flow modelling, using the inputs discussed in this report.

23 ADJACENT PROPERTIES

There are no adjacent properties relevant to the Turmalina Mine Complex.

24 OTHER RELEVANT DATA AND INFORMATION

No additional information or explanation is necessary to make this Technical Report understandable and not misleading.

25 INTERPRETATION AND CONCLUSIONS

Both open pit and underground mining methods have been employed on the property, however, only the underground mine is currently operating.

GEOLOGY AND MINERAL RESOURCES

- It is RPA's opinion that the Turmalina Mineral Resource estimates were prepared in a professional and diligent manner by qualified professionals and that the estimates comply with CIM (2014) definitions.

- The total Mineral Resources for the Turmalina Mine Complex comprise approximately 3.92 million tonnes at an average grade of 5.53 g/t Au containing 697,000 ounces of gold in the Measured and Indicated Mineral Resource category and approximately 2.74 million tonnes at an average grade of 6.00 g/t Au containing approximately 529,000 ounces of gold in the Inferred Mineral Resource category. The Mineral Resources include the Turmalina deposit and two satellite deposits, Faina and Pontal. A cut-off grade of 2.10 g/t Au was used to report the Mineral Resources for the Turmalina deposit, and cut-off grades of 3.8 g/t Au and 2.9 g/t Au were used to report the Mineral Resources for the Faina and Pontal deposits, respectively.

- Reconciliation studies on a quarterly basis show that the monthly Mine-to-Plant (F2) results exhibit a good correlation between the mine and the plant data throughout most of the 2017 and 2018 production periods, with the monthly block model predicted grades being generally more than those processed by the plant and the block model predicted tonnes being generally less than those processed by the plant.

- In general terms, RPA observes that there is good agreement between the plant data and the block model for the 2017 and 2018 period. RPA is of the opinion that this agreement is suggesting that the sampling strategies, assaying methods, and estimation procedures currently used at the mine to prepare the grade block models are producing reasonable predictions of the tonnages, grades, and contained metal that are being received at the processing plant.

- In RPA's opinion, the observed reconciliation variances can be ascribed to four factors:
  - Inaccuracies in the CMS shapes,
  - Inaccurate estimates of the block model tonnages and grades due to the use of designed stope volumes rather than CMS shapes,
  - The discovery of additional ore during the development process that was not captured by the block model, and
  - Overall block model predicted grades being too high due to slightly optimistic capping values.

- Two new mineralized lenses discovered in 2018 are located between Orebody A and the previously known lenses comprising Orebody C.

MINING AND MINERAL RESERVES

- The Turmalina Mine is a well run and professional operation. The mine produces 1,500 tpd.
- It is RPA's opinion that the Turmalina Mineral Reserve estimates were prepared in a professional and diligent manner by qualified professionals and that the estimates comply with CIM (2014) definitions.
- Proven and Probable Mineral Reserves total 1.41 million tonnes at a grade of 5.05 g/t Au, containing approximately 228,000 ounces of gold. Mineral Reserves are limited to Orebody A and Orebody C.
- Mineral Reserves support a mine life of four years.
- The thicker portions of Orebody A, now considered for transverse mining in a primary/secondary sequence, comprise the highest grade, most productive portion of the Mineral Reserves. The majority of Orebody A will be mined using longhole stoping in a retreat sequence.
- Comparing Levels 7, 8, 9, and 10 shows that the thicker, high grade portion of Orebody A is increasing in lateral extent with depth. This trend has continued to the planned level of 13, however, the overall strike of the orebody has decreased.
- There is good potential for increasing Mineral Reserves by completing infill drilling of Inferred Mineral Resources at depth in Orebody A.
- The removal of rib pillars and timely placement of paste fill has greatly improved extraction of the orebody and has increased the mill feed tonnage.

METALLURGY AND PROCESSING

- The plant at the Turmalina Mine is well run and achieves consistent recoveries.
- Production capacity for the plant exceeds the ability of the mine to deliver ore.

CAPITAL AND OPERATING COSTS

- Direct capital costs over the LOMP total $16.7 million including $9.3 million for the mine and $7.4 million for exploration. The direct capital spent in the mine is for new equipment.
- Sustaining capital costs are estimated to be $15.6 million, of which $0.8 million is spent on rebuilds. Reclamation and closure costs are estimated to total $5.1 million.
- LOM operating costs are forecast to average $85.00/t. Strengthening of the US dollar against the BRL over the last few years has had a significant impact in reducing US$ unit costs. Jaguar used an exchange rate of US$1.00 = 3.70 BRL for 2019. The exchange rate assumptions are consistent with forecasts.

- All-In Sustaining cost (as defined by the World Gold Council) for the Turmalina Mine is $1,048/oz, including reclamation and closure.

26 RECOMMENDATIONS

RPA has the following recommendations:

GEOLOGY AND MINERAL RESOURCES

EXPLORATION

- The results obtained from the Zona Basal target area merit further examination by means of a preliminary diamond drilling program. In RPA's opinion, the soil sampling and geological mapping programs should be extended along the southwestern projection of the Zona Basal stratigraphy to search for the presence of additional gold-bearing mineralization in this area.

- Exploration drilling of the down-plunge and along-strike projection of Orebodies A and C is warranted and justified.

- Consideration should be given to locating additional, parallel mineralized zones in the hanging wall of Orebody B and in the footwall units of Orebody C.

QUALITY ASSURANCE/QUALITY CONTROL

- The QA/QC program should be amended to include the channel samples.

- The database should be amended as a minimum to improve the data extraction functionality so that standard QA/QC control charts can be prepared.

- The assay laboratory automatically re-assays all samples containing gold grades greater than 30 g/t Au, and the average of the re-assays are reported to the sites. All sample results should be reported to the site, without averaging.

- Make a slight modification to the drill hole database assay information where the final gold assay used to prepare grade estimates is the average of all assays for a given sample. At present, only the first assay is used. This information can be captured by the creation of an additional column in the assay table.

- Establish clear criteria for acceptance or rejection of drill hole and channel sample data in the drill hole database.

- Establish data screening protocols for review of data quality for newly acquired data prior to inserting into the master database.

- Send a small number of pulps from the 2018 drilling program to an external laboratory for duplicate analysis.

- The threshold of 30 g/t Au is high. Re-assay thresholds of 10 g/t Au to 15 g/t Au are commonly used in other gold operations.

- Include the certificate number for each assay batch into the central BDI database.

- Update the central BDI database to store drill core recovery, channel sample recovery, and sample tracking (lost sample) information. This will assist in deciding how to address null values in future resource estimates.

- Carry out a review of the surveying practices and quality control procedures being used to ensure that all drill hole collars are accurately located prior to entry into the final drill hole database.

MINERAL RESOURCES

- Complete updating the written procedures for the collection of geological and sampling information. Conduct a training session to present the procedures to all geological staff. The written procedures for entry of this data into the central database and its management should also be completed.

- Update the core logging and sampling procedures so that the logging geologist ensures that a full series of samples are taken through those portions of the drill holes that are expected to intersect the mineralized zones. The samples should cover not only the expected mineralized intervals but extend a short distance into the adjacent wall rocks as well.

- Correct the erroneous or uncertain information for those excluded drill holes that are located in the as-yet unmined portions of the Turmalina deposit. For those drill holes and channel samples that remain, RPA recommends that they be removed from the active database into a database that is dedicated specifically for these records.

- Make a slight modification to the logging procedures whereby detailed information regarding the mineralized intervals will be brought forward from the remarks column and inserted as a major level entry in the drill logs to assist in preparation of future updates to the Mineral Resources.

- Code the block model for the mined out excavations using both the development and the stope excavation models.

- Carry out geological mapping of all available underground excavations in the vicinity of the Orebody C mineralized wireframes. The results of this geological mapping should be used to prepare a lithological model to be used to improve the allocation of the density measurements for future Mineral Resource updates.

- Modify the mineralized wireframe construction strategy to use a cut-off grade that more closely reflects the Mineral Reserve cut-off grade for each orebody.

- Continue to collect bulk density measurements for any newly discovered mineralization.

- Undertake studies to examine the relationship of the gold values to structural, alteration, or lithologic features (such as the presence of quartz veining, for example) to aid in the understanding of the distribution of the higher grade gold values seen in Orebodies A and C.

- Re-examine the stratigraphic/lithologic controls on mineralization for Orebody B for the possibility of generating drill targets.

- Consider the use of a dynamic anisotropy method for estimation of gold grades into the model.

- Review the U-Fo estimation method as developed by the Advanced Laboratory for Geostatistical Supercomputing (ALGES), at the University of Chile in Santiago for preparing grade estimates for non-tabular mineralized zones.

- Carry out a short study to search for the optimum selection of input parameters to reduce the number of estimation artifacts for several mineralized lenses in Orebody C that have areas of lower sample density. The study should begin with the examination of the impact of the number of informing samples per quadrant on the resulting estimate.

- Collect additional drill hole information in these areas to improve the confidence level of the Mineral Resource estimate, to reduce and remove the estimation artifacts, and to search for the down-dip projections of the mineralization.

- Re-evaluate the Mineral Resource estimates for the Faina and Pontal deposits if any material changes occur to the values of the cut-off grade input parameters.

MINING AND MINERAL RESERVES

- Consider modelling mining costs by orebody, such that variable and incremental cut-off grades can be determined by orebody and the Mineral Reserve estimate, LOMP, and processing capacity can be optimized.

- Monitor geotechnical and modifying factor performance of the newly adopted primary and secondary transverse stopes to determine where improvements in mine planning can be achieved.

- Integrate ground control and rock mechanics analysis into the mine planning process to improve stability and reduce dilution.

- Balance production levels between Orebody A and Orebody C for improved production stability and operationally achievable plan over the LOM.

- Consider an annual long term planning cycle inclusive of strategic asset planning, Mineral Resource, and Mineral Reserve estimation for all Jaguar operations.

- Balance production levels between Orebody A and Orebody C for improved production stability and plan achievability over the LOM.

- The cost data available from Turmalina is not easily categorized. Unit mining costs vary between Orebody A and Orebody C, given significant differences between mining width, production rates, ground conditions, and haul distances. The mill has excess production capacity, not otherwise put to use. Undertake a detailed incremental cost analysis, split by orebody, to ensure that uneconomic material is not sent to the mill.

MINERAL PROCESSING AND METALLURGICAL TESTING

- Based on the information provided, the metallurgical testwork on samples from the Faina, Pontal, and Orebody D deposits has been carried out to a preliminary level only. Metallurgical testing should continue on these potentially refractory deposits to help determine the most appropriate processing route to be adopted.

- Options for the use of excess processing capacity for toll milling should be investigated.

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28 DATE AND SIGNATURE PAGE

This report titled "Technical Report on the Turmalina Mine, Minas Gerais State, Brazil" and dated April 5, 2019 was prepared and signed by the following authors:

(Signed and Sealed) ***Jeff Sepp***

Dated at Toronto, ON
April 5, 2019

Jeff Sepp, P.Eng.
Senior Mining Engineer

(Signed and Sealed) ***Reno Pressacco***

Dated at Toronto, ON
April 5, 2019

Reno Pressacco, M.Sc. (A), P.Geo.
Principal Geologist

(Signed and Sealed) ***Avakash Patel***

Dated at Toronto, ON
April 5, 2019

Avakash Patel, P.Eng.
Principal Metallurgist

29 CERTIFICATES OF QUALIFIED PERSONS

JEFF SEPP

I, Jeff Sepp, P.Eng., as an author of this report entitled "Technical Report on the Turmalina Mine, Minas Gerais State, Brazil" prepared for Jaguar Mining Inc., and dated April 5, 2019, do hereby certify that:

1. I am a Senior Mining Engineer with Roscoe Postle Associates Inc. of Suite 501, 55 University Ave Toronto, ON, M5J 2H7.

2. I am a graduate of the Laurentian University, Sudbury, Ontario, Canada, in 1997 with a Bachelor of Engineering degree in Mining Engineering.

3. I am registered as a Professional Engineer in the Province of Ontario (Reg. #100139899). I have worked as a Mining Engineer for a total of 22 years since my graduation. My relevant experience for the purpose of the Technical Report is:
    - Review and report as a consultant on many mining operations and projects around the world for due diligence and regulatory requirements
    - Feasibility Study project work on many mining projects, including South American projects.
    - Operational experience as Planning Engineer and Senior Mine Engineer with three North American mining companies
    - Work as a mining engineer consultant on various projects around the world

4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

5. I visited the Turmalina Mine on December 11, 2018.

6. I am responsible for Sections 15, 16, 18 to 22, and 24 and relevant disclosure in Sections 1, 2, 3, 25, 26, and 27 of the Technical Report.

7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.

8. I have had no prior involvement with the property that is the subject of the Technical Report.

9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 5th day of April, 2019

(Signed and Sealed) ***Jeff Sepp***

Jeff Sepp, P.Eng.

RENO PRESSACCO

I, Reno Pressacco, M.Sc., P.Geo. as an author of this report entitled "Technical Report on the Turmalina Mine, Minas Gerais State, Brazil", prepared for Jaguar Mining Inc. and dated April 5, 2019, do hereby certify that:

1. I am Principal Geologist with Roscoe Postle Associates Inc. of Suite 501, 55 University Ave., Toronto, ON, M5J 2H7.

2. I am a graduate of Cambrian College of Applied Arts and Technology, Sudbury, Ontario, in 1982 with a CET Diploma in Geological Technology, Lake Superior State College, Sault Ste. Marie, Michigan, in 1984, with a B.Sc. degree in Geology and McGill University, Montreal, Québec, in 1986 with a M.Sc.(A) degree in Mineral Exploration.

3. I am registered as a Professional Geologist in the Province of Ontario (Reg. #939). I have worked as a geologist for a total of 33 years since my graduation. My relevant experience for the purpose of the Technical Report is:
    - Review and report as a consultant on numerous exploration and mining projects around the world for due diligence and regulatory requirements, including preparation of Mineral Resource estimates and NI 43-101 Technical Reports.
    - Numerous assignments in North, Central and South America, Finland, Russia, Armenia and China in a variety of deposit types and in a variety of geological environments; commodities including Au, Ag, Cu, Zn, Pb, Ni, Mo, U, PGM and industrial minerals.
    - A senior position with an international consulting firm.

4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

5. I visited the Turmalina Mine on November 20, 2014 and December 13, 2017.

6. I am responsible for Sections 4 to 12, 14, and 23 and related disclosure in Sections 1, 2, 3, 25, 26, and 27 of the Technical Report.

7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.

8. I participated in an audit of Jaguar's Brazilian operations in February 2014 and co-authored a Technical Report on the Turmalina Mine in 2015, 2016, and 2017.

9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 5th day of April, 2019

(Signed and Sealed) ***Reno Pressacco***

Reno Pressacco, M.Sc. (A). P.Geo.

AVAKASH PATEL

I, Avakash Patel, P.Eng., as an author of this report entitled "Technical Report on the Turmalina Mine, Minas Gerais State, Brazil" prepared for Jaguar Mining Inc., and dated April 5, 2019, do hereby certify that:

1. I am Vice President, Metallurgy and Principal Metallurgist with Roscoe Postle Associates Inc. of Suite 501, 55 University Ave Toronto, ON, M5J 2H7.

2. I am a graduate of the University of Regina, Saskatchewan in 1996 with a B.A.Sc. in Regional Environmental Systems Engineering (Civil/Chemical).

3. I am registered as a Professional Engineer in the Province of Ontario (Reg. #90513565) and in the Province of British Columbia (Reg. #31860). I have worked as a metallurgical engineer for a total of 22 years since my graduation. My relevant experience for the purpose of the Technical Report is:
   - Reviews and reports as a metallurgical consultant on numerous mining operations and projects for due diligence and regulatory requirements.
   - Senior positions at numerous base metal and precious metal operations, and consulting companies responsible for general management, project management, and process design.
   - Sr. Corporate Manager – Metallurgy and Mineral Processing with a major Canadian mining company and a junior Canadian mining company.
   - Manager of Engineering/Processing Engineering with two large international Engineering companies responsible for designing, planning, and execution for multiple complex mining projects.

4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

5. I did not visit the Turmalina Mine.

6. I am responsible for Sections 13 and 17 and related disclosure in Sections 1, 2, 3, 25, 26, and 27 of the Technical Report.

7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.

8. I have had no prior involvement with the property that is the subject of the Technical Report.

9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated 5th day of April, 2019

(Signed and Sealed) ***Avakash Patel***

Avakash Patel, P.Eng.